FEBRUARY • 1954
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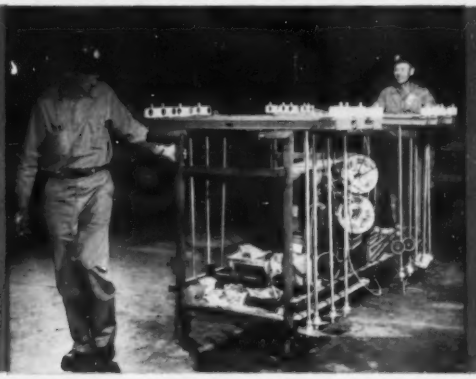
ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

Mobility and mechanization speed electrical installation by Schulman Electric Co. at Paducah atomic energy project.



A special report on a history-making application of modern tooling and job technology to electrical construction.

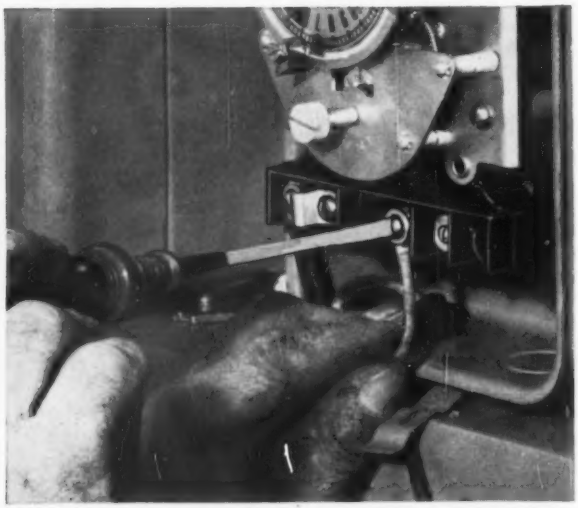
See Page 65

A McGRAW-HILL PUBLICATION | 53RD YEAR

1 ATTACH SWITCH TO MOUNTING SURFACE: Hang by means of lug at top, secure with two screws through holes in case—takes only a few seconds; rugged, drawn-steel housing makes T-27 suitable for any outdoor-indoor installation.

2 SET DIAL: Adjust to correct time, position trippers for desired on-off period—easy as setting a wrist watch. With omitting device, T-27 skips days; with astronomic dial, follows dusk-dawn schedule; performs 10 on-off operations daily.

Reduce Installation Time With Dependable General Electric Time Switches



3 WIRE: Connect to clearly marked, readily accessible terminal blocks at front of T-27—requires little time. A minimum of circuit connections, maximum hand room below terminals and five double knockouts facilitate quick wiring.

3 Simple Steps Make Installation of General Electric's T-27 Time Switch Extremely Fast and Easy

ONCE INSTALLED and set, the T-27 will give years of reliable, dependable on-off control.

ACCURATE TIMEKEEPING is assured by a self-starting, self-regulating, permanently lubricated Telechron* motor, sealed to keep out dirt and dust.

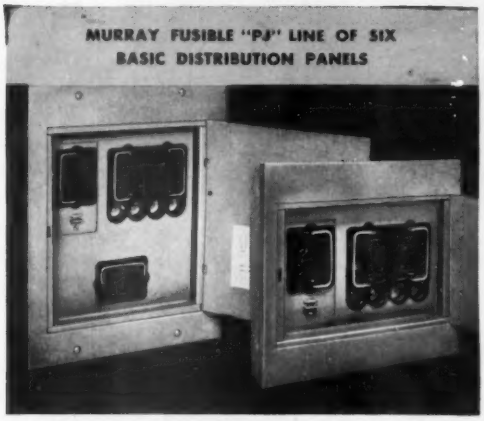
RUGGED CONSTRUCTION insures little maintenance. All parts of T-27 switch mechanism subject to heavy duty are made of copper-nickel-plated steel, and switch blades are of beryllium copper for the best combination of mechanical and electrical characteristics.

FOR MORE INFORMATION on T-27, contact your nearest authorized G-E Time Switch distributor. Ask for G-E Time Switches at his store; and write for Bulletins GEA-5965 and GEC-535C to Section 603-168, General Electric Company, Schenectady 5, N. Y.

*Reg. Trade-mark of General Electric Co.

GENERAL ELECTRIC

NEW MURRAY "PJ" LINE CUTS COSTS...SAVES TIME!



This 60-amp fusible equipment comes with 3 or 4 pull-outs and 4, 6 or 8 branch circuits, in series or parallel. Handles almost any load combination. Panels have dead front construction, are finished in attractive baked-on grey Melamine. Famous Murray quality throughout.

Everything: Main, Lighting & Appliance, and Power circuits—complete in one compact box. Everything goes up at one time. Note special sealable compartment containing one pullout—ideal for separate rate off-peak water heating. Barrier removable when not required.

. . . helps you meet increased loads at decreased costs!

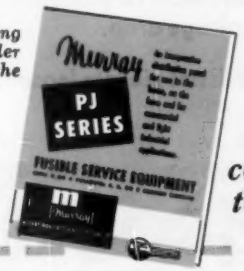
The attractive, low-cost PJ line is designed to help you handle increased loads on home, farm and commercial jobs with a minimum of equipment. With only six basic panels you get full-line versatility for almost any combination of light, appliance and power circuits. Minimum-stock line also means easier ordering and stocking for you.

. . . saves you more time and money on installation!

Putting up PJ panels is clean, fast work with installation time cut to the bone. There are plenty of clean-cut, easy-to-remove KO's just where you want them. Plenty of knuckle room, too. And no wire fumbling—you'll find high quality solderless connectors on all terminals conveniently located. Surface hook-on cover saves extra time.

In every way, Murray PJ panels are ideal for low-cost installations. Your Murray wholesaler has them now. Lay in a supply today and be ready for any job that comes along.

For complete details and wiring diagrams, ask your wholesaler for Bulletin 231, or send the coupon in.



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Gentlemen: Please send me Bulletin 231 on the new Murray PJ series of distribution panels.

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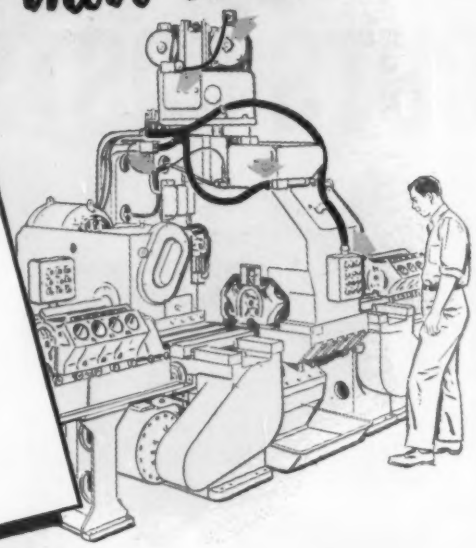
for

Liquid Tight Flexible Conduit

("Sealtite" or Equivalent Products)

*Patent Applied For



NOTE THESE EXCLUSIVE FEATURES

- Positive ground between flexible conduit and connector.
- Less than 10 millivolts voltage drop.
- Will not vibrate loose.

QUICK and SIMPLE TO INSTALL

Meet UL and JIC Standards

Cut conduit (1) to desired length. Pass nut (2) over conduit. Screw ferrule and sleeve assembly (3) into conduit. Insert ferrule assembly in connector body (4) Tighten down the nut (2) as far as possible, thus collapsing sleeve wall and forming a liquid-tight seal. (When liquid-tight connection is required for knockout of steel junction box, a gasket assembly (5) and locknut (6) are used.)

QUICK, EASY to INSTALL... Complete from ONE Source

■ On any machinery wiring job, contract or time and material, you'll do better with *Appleton* "ST" Series Liquid Tight Connectors.

First, they provide the protection the job requires. *Second,* they are engineered for quick, easy installation . . . even an apprentice can complete a job that will pass inspection! *Third,* ALL parts are supplied from *one* source . . . your wholesaler carries a complete stock.

Appleton "ST" Series Connectors come straight, 45° and 90° to fit flexible conduit sizes from ⅜" to 1¼". Also 1½" and 2" straight.

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Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

53rd Year—FEBRUARY • 1954

Washington Report 59

Comments on "The Wrong Road" 61

Out With Over-Thirty Wire 63

New "Mobile-Mechanized" Techniques 65

By AUGUST ECKEL—At the Paducah A.E.C. project, Schulman Electric Co. put all tools on wheels to cut installation time.

New Planning Ideas for Modernizing Office Buildings ... 70

A job-procedure plan for electrical modernization work in office buildings.

15 Case Studies of Electric Heating 78

Some specific examples where infrared lamps, all-metal radiant units, and resistance heating cables have paid big dividends.

Service Shop Features Efficiency 84

By E. DALTON WHITE—New quarters of Electrical Equipment Company's Augusta, Ga., branch include motor repair shop, warehouse and office areas.

Appliance and TV Sales Top $7-Billion in 1953 88

By R. W. ARMSTRONG—Industry is 18.4% ahead of 1952.

How to Estimate Temporary Wiring 90

By JOHN P. REYNOLDS—Some of the problems involved in estimating temporary wiring.

Coordinated Protection of Electric Motors 93

An analysis of the function of each protective device in an electric motor branch circuit as required by the Code.

Modern Lighting 101

Huge luminaire lights MIT library; integrated ceiling for light, sound, air; dual-purpose ceiling modernizes bank.

Motor Shops 109

Memory dial added to dynamic balancer; portable agitator for varnish tank; rotary trough-rack for slot insulation.

Practical Methods 118

Automatic angle-indicator speed conduit bending; versatility obtained by simple installation.

Reader Service 129

Product news announcements; catalogs and bulletins available.

Reader's Quiz 155

Questions and answers on lubricating ball bearings; capacitor start motors; motor protection.

Questions on the Code 161

Answers to code questions including service equipment multiple occupancy; grounding panels to system grounding conductors.

In the News 179

Dates Ahead 187

Data Sheet 195

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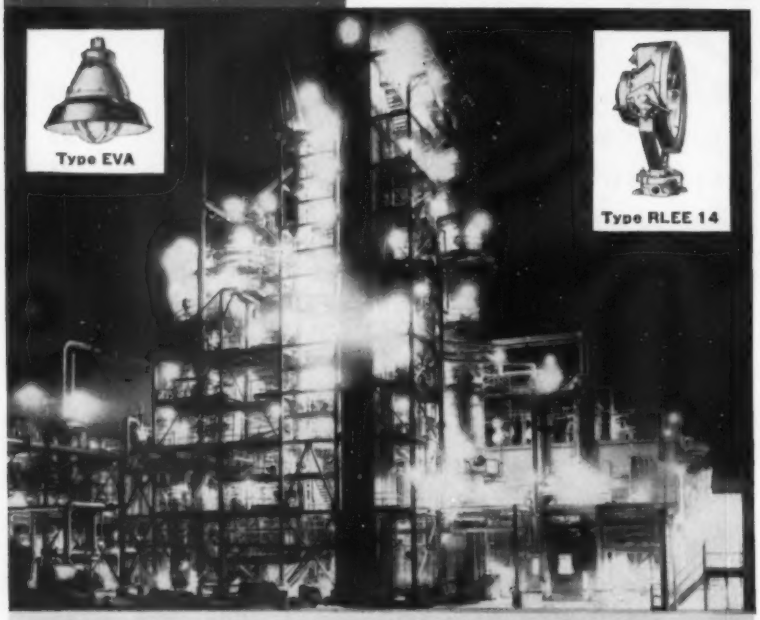
You can increase production at night
CROUSE-HINDS Floodlights

. . . and they're great for protective lighting too!



A petroleum refinery lighted for round-the-clock operation with Crouse-Hinds Type EVA Explosion-Proof and Raintight Industrial Lighting Fixtures, and Type RLEE-14 Explosion-Proof Floodlights.

Production curves go up when Crouse-Hinds high efficiency floodlights are installed in yards and approaches to industrial plants.

The usefulness of many outdoor areas can be multiplied by flooding them with controlled illumination. Crouse-Hinds all-inclusive line with short, medium, and long range projectors makes it possible to get the right amount of light at the locations where it is needed. This control insures the clarity of daylight where it will do the most good, without wasteful over lighting of unused areas.

Frequently it will cost much less to project light a considerable distance with Crouse-Hinds long range floodlights than to run cable and install local lighting. There are also indoor locations in large buildings where floodlights are the most economical and satisfactory source of light.

Plenty of light is also the most reliable and cheapest form of protection against night prowlers. Sabotage and pilferage thrive in darkness. Crouse-Hinds floodlights project powerful beams of light that bathe all approaches to your property with glaring radiance, compelling everyone to be more visible than in broad daylight.

A factory yard lighted by Crouse-Hinds Type RCD-12 Lighting Fixtures. These fixtures are easy to install on buildings and are often set in the walls during construction.

This posed photograph shows the value of Crouse-Hinds searchlights for protective lighting. Their powerful beam quickly "spots" night prowlers.

FLOODLIGHTS AIRPORT LIGHTING

by using
to *turn night-time into day-time*

You will find exactly what you need in CROUSE-HINDS all-inclusive line

Explosion-Proof Floodlights. Wherever there is a possibility of the presence of explosive atmospheres, Crouse-Hinds explosion-proof floodlights will give you maximum protection. The complete line includes explosion-proof portable floodlights for temporary or emergency use.

Heavy Duty Floodlights. Crouse-Hinds line of heavy duty floodlights includes 200, 250, 500, 1000, 1500 and 2000-watt medium, and long range projectors. The slightly higher first cost is offset by lower installation and maintenance costs wherever large areas are to be lighted.

Searchlights. The mere presence of Crouse-Hinds searchlights discourages attempts at illegal entry. When such attempts are made the rascals flee in confusion the moment they are "picked up" by the powerful beam of light. Four different sizes meet every need. All can be furnished with pilot house control that permits the searchlight to be on a roof, operated from the room below.

General Purpose Floodlights. Crouse-Hinds complete line of general purpose floodlights provides efficient lighting at minimum first cost. They are widely used for lighting yards and parking lots and are ideal for industrial recreation areas and athletic fields.

Special Applications. The Crouse-Hinds line includes a number of fixtures designed for mounting in walls or ceilings for the efficient lighting of tunnels, underpasses, bridges, drives, walks, and loading areas. An ornamental lantern floodlight does a real lighting job in areas where appearance is an important factor.

A Crouse-Hinds floodlighting installation pays off in: (1) increased production; (2) prevention of accidents; (3) protection against dangerous prowlers. Pioneers in floodlighting, Crouse-Hinds illumination engineers have accumulated a wealth of lighting knowledge that is at your service. Write for additional information and ask for your FREE copy of Crouse-Hinds Bulletin 2652 "Lighting Equipment". It contains listings of hundreds of types and sizes of floodlights and explosion-proof, dust-tight, and vaportight industrial lighting fixtures.

Crouse-Hinds Type ADE-16 Heavy Duty Floodlights are used to "turn night-time into day-time" at this plant for 24-hour production.

A parking lot efficiently lighted by Crouse-Hinds Type FLA General Purpose Floodlights.

CROUSE-HINDS COMPANY
Syracuse 1, N.Y.

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where reliability is the first requirement . . .

it's SPANG® Conduit

for Manhattan's new Beekman-Downtown Hospital

The new, modern Beekman-Downtown Hospital, located on New York's East Side, was especially designed to serve the unusual variety of medical needs found in this type of neighborhood. This 5½-million-dollar hospital is equipped with an extensive out-patient department for accidents and emergency work, large charity wards and beautifully equipped private rooms—plus especially attractive quarters for interns, nurses and other staff members.

The many and unusual electrical requirements of a hospital call for the very finest electrical installations. That's why Spang Conduit was chosen to protect the wiring throughout the building. Spang Conduit is quality-controlled from raw material to finished product. This means Spang Conduit is easier to work with . . . easier to cut, bend and thread . . . providing an economical, time-saving installation.

And where reliability is so important, a Spang installation can be counted on to give years of satisfactory and dependable service. Ask any architect or contractor. They'll tell you the same thing.

Specify Spang for your next job. Take your choice of Spang Cenlaco "Hot-Dipped," Spang Central White Electrogalvanized, Spang Central Black or the new Spangleam EMT. Your distributor carries the complete Spang line.

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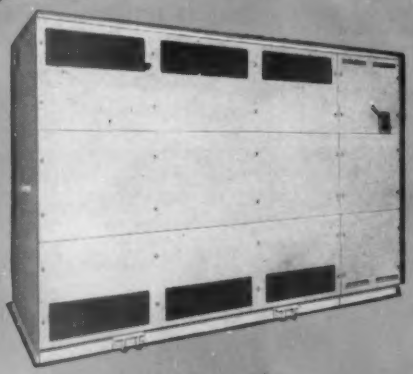

Typical Indoor Dry-Type Load Center Transformer (2400 Volts and Above)

Typical Dry-Type, Air-Cooled Transformer (600 Volts and Below)

Typical large Distribution Transformer Available in Standard Ratings of 167, 250, 333 and 500 Kva.

Higher distribution voltages give greater operating efficiency to electrical equipment through greatly improved voltage regulation. Industrial power rates are appreciably lower at higher distribution voltages.

Today's trend is toward consumers installing their own transformers to realize these sizeable savings and to achieve this improved voltage regulation.

Your local utility can advise you concerning the distribution voltage best suited to your needs.

In order to achieve the ultimate savings possible, specify Moloney Transformers. You will find, as many utilities already know, that Moloney Transformers afford the following features of prime importance:

1. **Efficient Operation**
2. **Location Flexibility**
3. **Low Maintenance Cost**
4. **Quiet Operation**

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Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers Step Voltage Regulators • Unit Substations

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GREATER RELIABILITY
LESS MAINTENANCE

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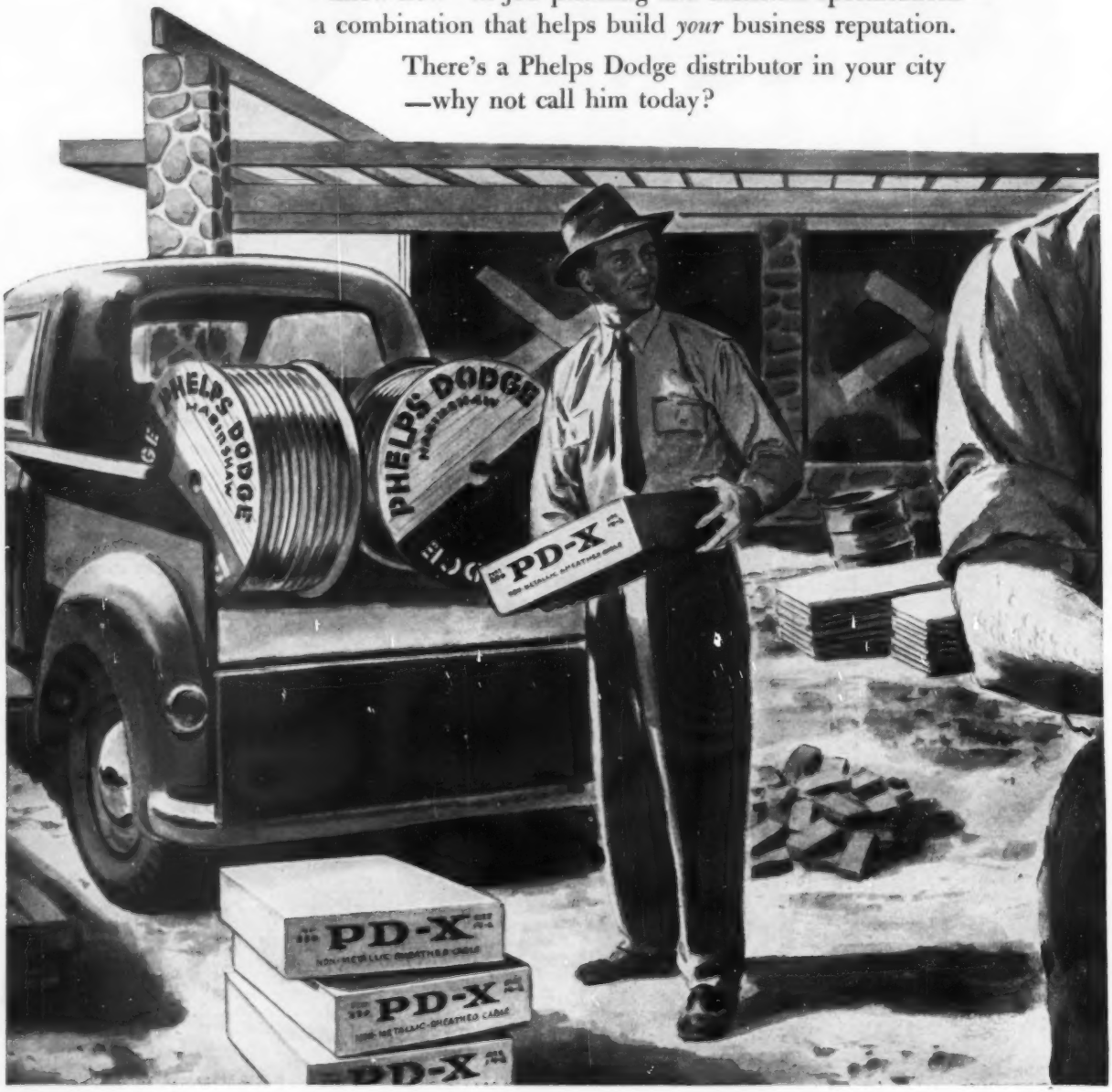
When you call your Phelps Dodge distributor, you can be sure of getting the kind of help that speeds job completion . . . gives you full job profit.

He offers you two important aids: the highest quality materials and a wide background of experienced "know-how" in job planning and materials specifications—a combination that helps build *your* business reputation.

There's a Phelps Dodge distributor in your city —why not call him today?



are as near as your Phelps Dodge distributor's telephone!

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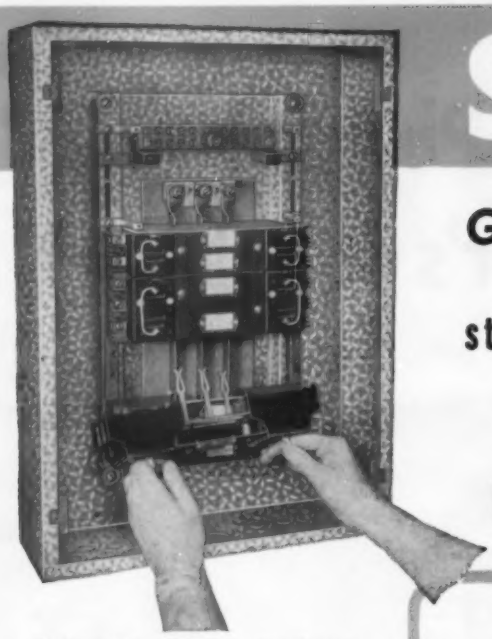
WIRE BY PHELPS DODGE MEANS WIRED FOR LIFE!

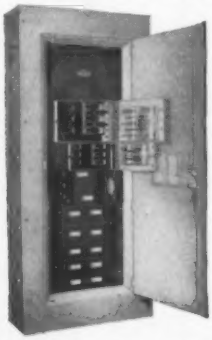


SAVE TIME . . . LABOR

Get faster deliveries with standardized FA interchangeable

PLUG-IN FEEDER PANELBOARDS

Pulfuzswitch Type of Panelboard with 30 ampere, 2 and 3 pole branches. Box is 19½" wide and 4¾" deep.



Panelboard illustrated is a combination of Pulfuzswitch and Klampswitchfuz branches. Box size is 24" wide and 10" deep.

Branch Circuit capacities are as follows:

- **FA PULFUZSWITCH**
  30, 60 and 100 amperes, 250 volts AC or DC; 30 and 60 amperes, 600 volts AC, 2, 3 and 4 poles.
- **FA KLAMPSWITCHFUZ**
  30 to 600 amperes, 250 volts AC or DC, 2, 3 and 4 poles.
- **FA SNUFARC**
  30 to 200 amperes, 600 volts AC, 2, 3 and 4 poles.
- **FA SHUTLBRAK**
  30 to 1200 amperes, 250 volts AC or DC, and 600 volts AC, 2, 3 and 4 poles.

Here's a panelboard that measures up fully to the modern demand for safe, efficient, economical and dependable power and light distribution.

Built of standardized units and assembled as required for specific application, FA Interchangeable Plug-In Feeder Panelboards not only provide adequate capacity for today's needs, but are so designed that future additions of circuits and changes in capacity can be made a simple matter of adding new units.

Three dependable FA Switches — the Pulfuzswitch, Klampswitchfuz and the Snufarc — make these panelboards the finest in safety and efficiency. All types combine switch and fuse in one unit so that current is "OFF" when the fuse carrier is removed or the door opened. This makes replacement of fuses safe, quick and simple.

Boxes are standardized as to width, height and depth to meet any combination of branches or any job requirement. They are shipped from stock, thus facilitating delivery. Except for smaller sizes, all boxes have removable ends to permit drilling of conduit openings on the job. Smaller boxes have standard knockout layout in ends. Generous wiring space and ease of installation are other features.

For operating switch requirements FA Shutlbrak Type A quick make and quick break interlocking switches are available.

Want to know more about these modern panelboards? Your nearest FA representative, listed in Sweet's, will be glad to provide it.

Frank Adam Electric Co.

P. O. BOX 357 ST. LOUIS 3, MISSOURI

FA TRADE MARK

Our 62nd Year

Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER

A Century MOTOR With Gas Mask PROTECTION

Underwriters Approved

EXPLOSION PROOF MOTORS

Take a look at these Century Explosion Proof Motor features:

- Vital motor parts protected—sealed into inner frame.
- Motor can be reversed without changing direction of the fan—fan runs in either direction.
- Uniform ventilation surrounding outside of inner frame.
- Smooth, straight-through ventilating passages.
- Winding electrically insulated 6 different ways.
- Unusually free from vibration.
- Ball bearing housing keeps grease in—dirt out—lubricated for several years' normal service, with grease plugs for additional lubrication, if necessary.
- Easy-to-remove fan guard is held securely in place with two screws.
- Smooth exterior surface is easy to clean.
- Cast iron frame with integrally cast feet resists rust and corrosion—even when mounted in places where processed materials may contact the feet.
- Rugged construction gives generous safety factor for rough handling.

CE-760

Your property and employees are protected, because this Century Explosion Proof motor is totally enclosed—sealed to prevent a motor spark from causing an explosion.

Class I, groups C and D are used in atmospheres containing flammable gases or vapors: Ethyl ether vapors, gasoline, petroleum, napthha, alcohols, acetone, lacquer solvent vapors and natural gas.

Class II, groups E, F and G are used in atmospheres containing combustible dusts: Metal dust, carbon black, coal or coke dust and grain dusts.

Naturally, corrosive or abrasive materials in the air are also sealed out of the vital parts.

For your protection, specify Century motors on new equipment or for replacement. Your nearby Century Distributor will be glad to give you full information on the complete line of Century motors—from 1/8 to 400 horsepower. We are limited in some sizes of the Explosion Proof motor.

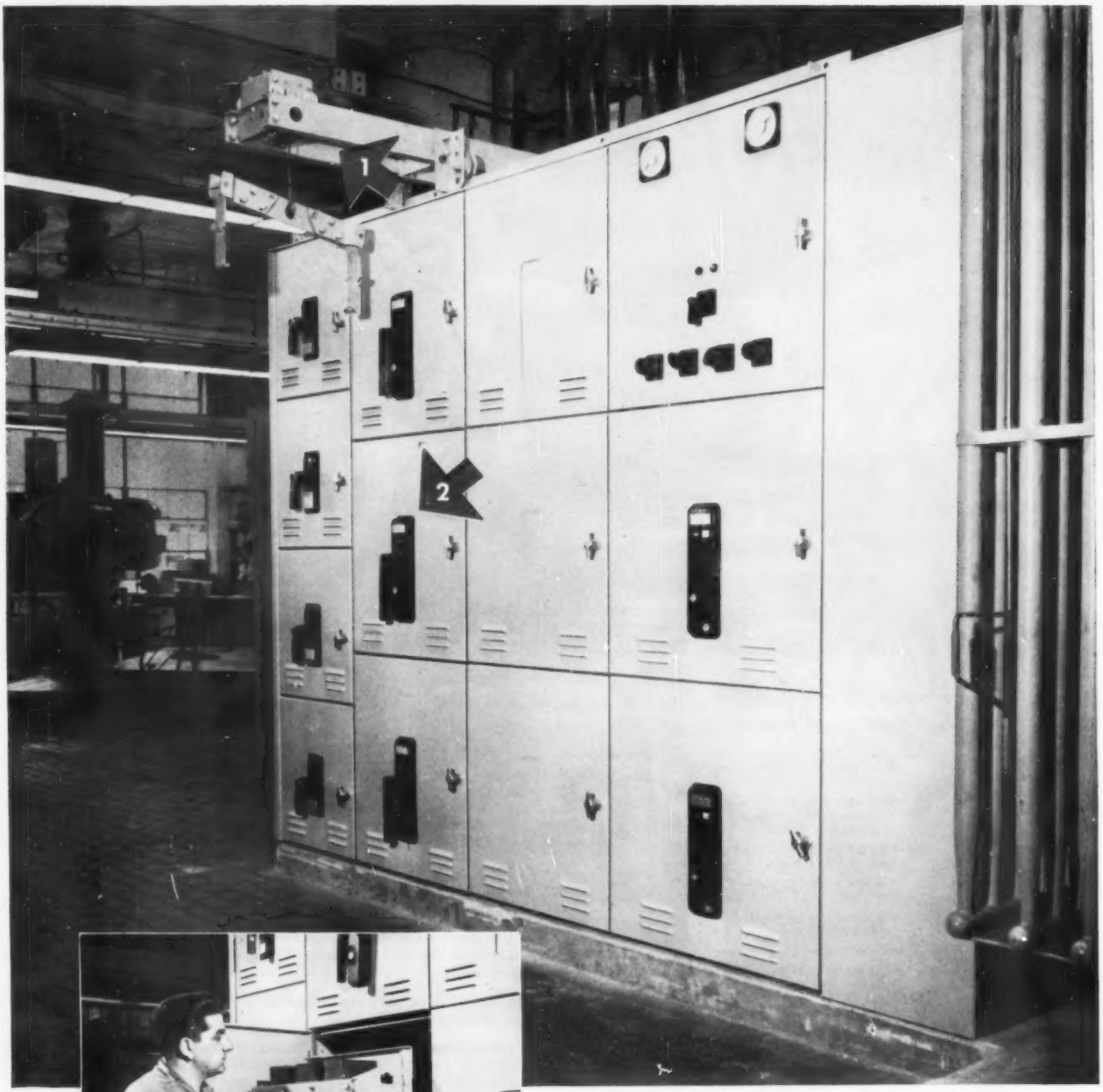
Century C MOTORS

CENTURY ELECTRIC COMPANY

1806 Pine Street • St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

New AK breaker equipment



LOAD CENTER UNIT (above) shows General Electric's new AK line of equipment installed in load area in industrial plant. Compact, neat in appearance, breaker and switchgear compartments form a completely co-ordinated unit. Breaker handling device (1) easily raises or lowers breakers into position. AK-1-50 breaker, shown here (2) in closed compartment is easily racked out by racking mechanism (3), shown at left, for inspection or maintenance.

gives *easier* breaker handling

Switchgear units are standardized—fully co-ordinated—tested to 100,000 amps.

General Electric's new indoor and outdoor drawout equipments with a complete line of Type AK air circuit breakers marks the first major improvement in low-voltage drawout switchgear design in the past 20 years.

Completely co-ordinated compartments and breakers make the new design smaller and more compact. Standardized compartments provide greater flexibility, permit faster delivery schedules and less maintenance.

Structure frame, bus supports, bus and connections of the new equipment have been designed and tested to withstand up to 100,000 amps short-circuit current. Isolation of both control wiring and terminal blocks within steel troughs also means greater reliability and safety than ever before.

A simplified, sturdy racking mechanism with positive interlocks on the breaker frame permits easy inspection of the breaker and mechanism.

All units are designed with provisions for a new breaker-handling device to raise or lower the breaker easily to or from any compartment. The lifting device may be left in position without interfering with operation of the switchgear.

Type AK breakers are available in all ratings from 25 to 4000 amps, continuous current and 15,000 to 100,000 amps interrupting ratings, with 30-cycle momentary ratings equal to full interrupting ratings.

Outstanding design features of the new AK breakers are highlighted by three G-E exclusives—

Stored-energy closing mechanism—for safer, surer closing even though control power is lost during closing operation—a G-E exclusive.

Selective operation—up to full interrupting rating—another G-E exclusive.

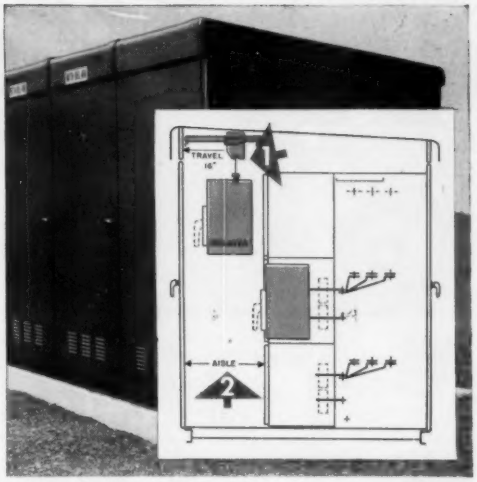
Interchangeable parts—on new breakers cut down your parts stocking problem and simplify maintenance.

Racking mechanism—is part of breaker and permits inspection outside compartment away from live parts.

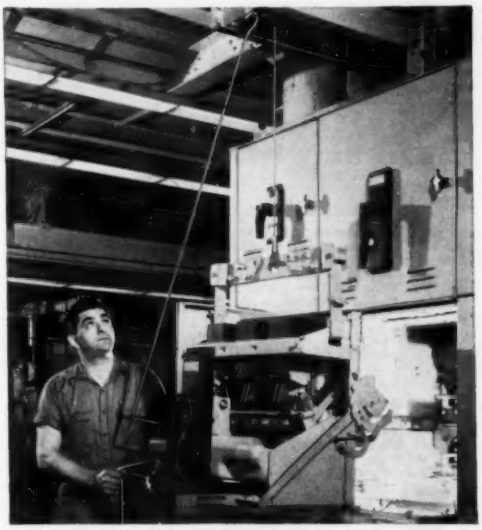
New equipments—designed and tested to withstand up to 100,000 amps. Design improvements give you many new features and benefits.

New breaker-handling device—is designed as integral part of units. Optional for both indoor and outdoor equipments.

For details on the new AK breaker—and new low-voltage drawout switchgear equipments—ask your G-E Apparatus sales representative for Bulletins GEA-5915 and GEA-5916, or write to General Electric Company, Schenectady 5, N. Y. 873-5



OUTDOOR EQUIPMENTS have built-in breaker lifting device (1) weatherproof "walk-through" aisle (2), access to either front or rear by weatherproof doors. Rubber gaskets at door, metallic filters over ventilation openings keep out dust, bad weather.



NEW BREAKER-HANDLING DEVICE, in action, can easily raise or lower G.E.'s compact new air circuit breaker. The new lifting device is optional on both indoor and outdoor equipments. It has a front-to-back travel to load a breaker on a truck.

You can put your confidence in—

GENERAL ELECTRIC

thousands already using it to help Plan Better Industrial Lighting...

HELPS PLAN

Thousands of architects are using it to help them plan the type and kind of lighting systems which will best fit the particular industrial building they are designing. They also use it to show their clients the reasons why the recommendations call for RLM-certified units.

HELPS BUY

It gives buyers by the thousands, such as industrial executives, operating chiefs or plant maintenance heads, dollars-and-cents reasons why RLM-labeled lighting units are the best buy in terms of quality, performance and sustained high lighting efficiency.

here's how this new "Blue-Cover" RLM SPECIFICATIONS BOOK is already helping thousands:

HELPS SELL

It enables thousands of electrical contractors, electrical wholesalers, etc. to point out to their customers EXACTLY WHAT THEY ARE GETTING for their lighting dollar. It shows why the RLM Label on a lighting unit takes the place of over 1,500 words of specifications!

HELPS RECOMMEND

To thousands of purchasing agents it serves as a valuable yardstick in their evaluation of industrial lighting . . . an accurate guide to sound recommendations based on a comparison of the merits of different lighting units. It tells them what to look for and how to estimate lighting equipment value.

HELPS SPECIFY

To thousands of lighting men whose job it is to specify lighting units, it puts at their fingertips *21* different RLM Specifications, many complete with light distribution curves and coefficient of utilization tables. All are ready-made for use when drawing up lighting plans, layouts or recommendations.

This newly-revised "Blue-Cover" edition of the RLM Specifications Book of Industrial Lighting Units has just been made available to everyone who buys, sells and specifies industrial lighting equipment. Already thousands of copies have been requested and put to productive use in the planning of better industrial lighting.

NEW "UPWARD LIGHT" UNITS

In case you have not yet sent for your copy, be sure to do so before the supply is exhausted. This latest "Blue-Cover" edition of the RLM Specifications Book has been expanded to 52 pages, covering over 83 sizes and types of RLM-certified industrial lighting units. Featured are new specifications which embrace 15 variations of three new "Upward Component" RLM Semi-Direct Fluorescent Units which direct from 20% to 30% of the light upward. Also incorporated are important revisions and clarifications of existing specifications including new tables of typical coefficients of utilization and lighting distribution curves.

A request on your letterhead will bring your copy of this new RLM Specifications Book, as well as the pocket-size "RLM Questions and Answers" booklet, by return mail, without cost or obligation. Send now for this invaluable reference work to help you plan better industrial lighting!

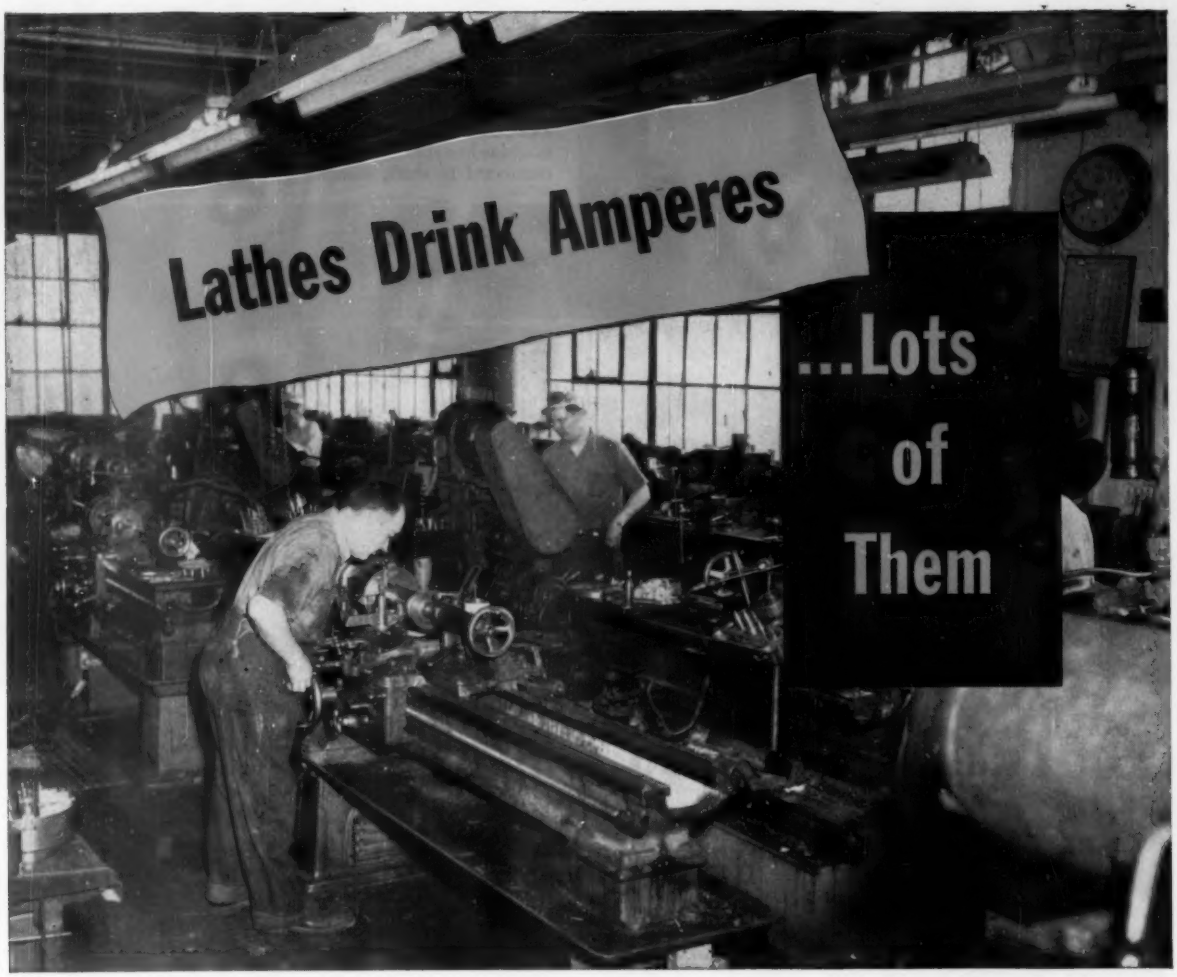
RLM Standards Institute, Suite 819, 326 West Madison Street, Chicago 6, Illinois.

R-352

MANUFACTURER'S NAME
COMPLIANCE WITH SPECIFICATIONS AND OPERATING CONDITIONS NOT GUARANTEED
ELECTRICAL TESTING LABORATORIES, INC.

RLM STANDARDS INSTITUTE
INCORPORATED

The letters RLM stand for Reflector and Lighting Equipment Manufacturers



Lathes, grinders, milling machines, drill presses and other machine shop equipment use plenty of amperes in their operations. If you slow down or stop these operations, you interrupt production; and when you interrupt production, you interrupt profit.

The power supply of these production tools must be constant. If equipment slows down because of poor wire and cable, work in process may be spoiled. If the production equipment stops, then machine time and labor are wasted.

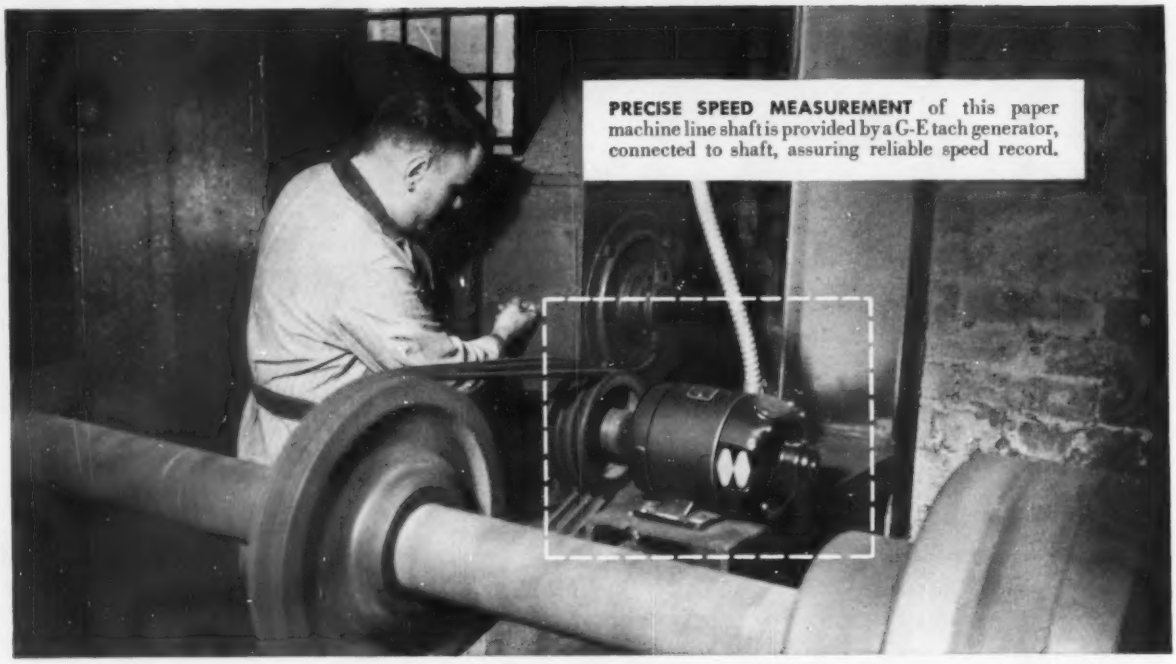
Simplex-ANHYDROPRENE Wires and Cables are ideal for wiring to machine tools. The neoprene jacket is resistant to oil mist and cutting oils. These wires are light in weight and small in diameter. They are fast and easy to install. Their smooth neoprene jacket permits easy pulling through conduit. They do not have fibrous braids to fray or rot.

Whether you are wiring a small laboratory shop, or a large production shop, use Simplex-ANHYDROPRENE Wires and Cables. You can depend on them.

Simplex

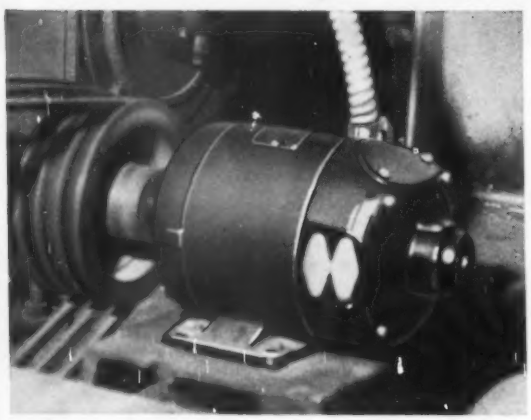
WIRES & CABLES

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Mass.



PRECISE SPEED MEASUREMENT of this paper machine line shaft is provided by a G-E tach generator, connected to shaft, assuring reliable speed record.

Get closer process control by measuring speed with G-E tachometer generator



G-E TACHOMETER GENERATOR connected to an indicating or recording instrument provides one of many accurate control systems obtainable with G-E d-c products.

A precise speed measuring method—using G-E tachometer generators—is one of the many advantages you get from General Electric d-c motors. The tach generator (shown at left) can be located as far as several thousand feet from a recording or indicating instrument. They indicate rotational speeds from 1 to 15,000 rpm . . . permit immediate manual speed adjustment.

BECAUSE ONLY D-C MOTORS can be controlled over a wide range of characteristics like speed, torque, voltage, etc., more and more G-E d-c products are being used to assure maximum utilization of expensive modern machinery. You can get efficient, more automatic, modern production with G-E d-c products such as the tachometer generator above, d-c motors, motor generator sets, amplidynes, and thy-mo-trol* motors.

USE D-C MOTORS for maximum efficiency, and remember that General Electric's Application and Sales Engineers can help you select the right d-c motor for the job to be done.

For more information see your local G-E Apparatus Sales Office or Authorized G-E Distributor. General Electric Company, Schenectady 5, N. Y. 704-11

*Reg. Trade-mark of General Electric Co.

You can put your confidence in—

GENERAL ELECTRIC

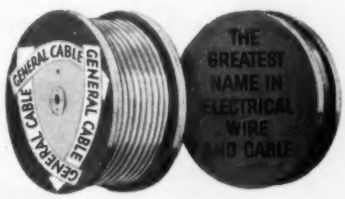
GENERAL CABLE

THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

To wire a plant, or wind a coil

IT PAYS TO BUY IN ONE PLACE!

Actually there is only one source for all of the types of wire and cable you may need...that's General Cable. To meet your every requirement, General Cable manufactures bare, weatherproof and insulated conductors of every variety ...maintains vast stocks...the broadest distribution facilities in the industry...ultra-modern plants coast to coast. Specify "General Cable." Don't settle for less.



GENERAL CABLE CORPORATION 420 Lexington Avenue, New York 17, New York

Sales Offices: Atlanta • Buffalo • Cambridge (Mass.) • Chicago • Cincinnati • Cleveland • Dallas • Detroit Houston • Indianapolis • Kansas City • Los Angeles • Milwaukee • Minneapolis • Newark (N. J.) • New York • Philadelphia Pittsburgh • Portland (Ore.) • St. Louis • San Francisco • Seattle • Syracuse • Tulsa • Washington, D. C.

MAXIMUM

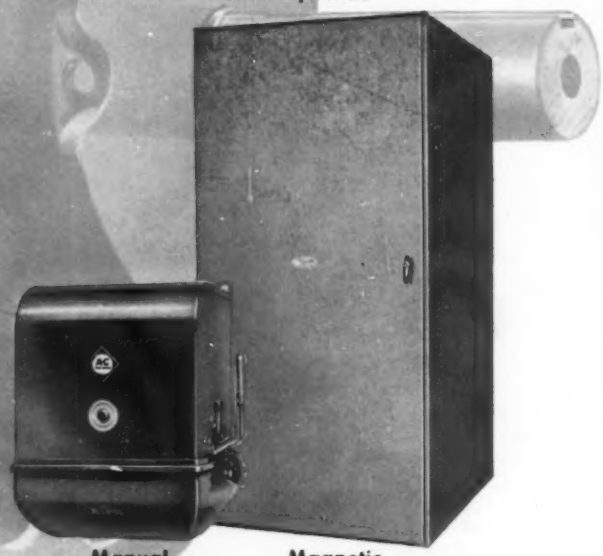
ALLIS-CHALMERS

STARTERS

Manual Magnetic Combination

Across-the-Line Starters

For squirrel-cage motors from fractional to 600 horsepower.



Manual Magnetic

Reduced Voltage Starters

For squirrel-cage motors from 5 to 2500 horsepower. Available in autotransformer, reactor and primary resistor types.

ALLIS-CHALMERS

is the producer of world's largest line of major industrial equipment. Out of the many Allis-Chalmers plants rolls the most diversified array of processing machinery as well as a complete line of electrical generating, distribution and utilization equipment. As a result, A-C engineers have been called upon to solve thousands of control problems in practically every industry. This broad experience in design, manufacture and application is yours when you specify . . .

ALLIS-CHALMERS CONTROL

ALLIS-

Line-to-Motor

PROTECTION

...The Right Starter for the Specific Job

Built into every Allis-Chalmers starter is the type and degree of protection dictated by the application. Let's take a theoretical example . . . a starter controlling a 1000-hp, 2300-volt synchronous motor driving a ball mill.

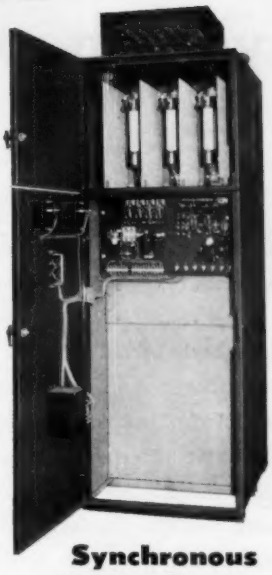
In this case the starter could offer the following protections:

1. Ac undervoltage protection
2. Three-phase thermal overload
3. Open and reverse phase
4. Damper winding
5. Instantaneous shutdown on pullout
6. Dc undervoltage
7. Dc field failure
8. Short circuit protection

Of course, specific protection requirements vary. That's why Allis-Chalmers starters are recommended and applied with expert personal attention to the problem at hand.

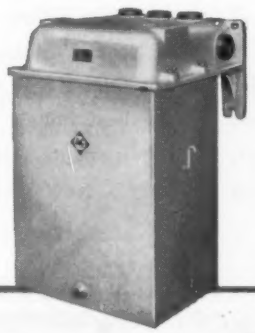
In addition to necessary protection, starter functions, varying with the specific job requirements, include full voltage or reduced voltage starting, acceleration, speed control, reversing or non-reversing and dynamic braking. All Allis-Chalmers starters are available in general purpose and special enclosures to meet your requirements.

For complete information call your nearby A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4250



Synchronous Motor Starter
features positive synchronizing, complete motor protection.

For Wound Rotor Motors
Available in manual, magnetic and semi-magnetic types.



For 2300-2500 Volt Squirrel-Cage Motors
Full voltage starting. Particularly applicable in dusty, corrosive atmospheres and hazardous locations.

CHALMERS

A-C ALLIS-CHALMERS

ADV.

IF YOU SPECIFY OR BUY FLUORESCENT FIXTURES:

Here is why General Electric believes you should insist on series ballasts for 96T12 lamps

Several years ago, our engineers studied the merits of the series-type ballast circuit for operating the 96T12 lamp at 425 ma. It showed real possibilities for economy, both in ballast cost and size. With concentrated efforts, a series ballast design for this lamp was perfected. Then for the first time, a series-type ballast circuit meeting all lamp requirements and giving full rated lamp life was made available to you.

Actually, there was nothing basically new about the series-type ballast. As early as 1940, our engineers had studied such a circuit. As new lamps were made available over the years, the series ballast was investigated time and again. However, prior to the 96T12 lamp, the potential savings of the series ballast circuit had been discarded because no way had been found to meet lamp operating requirements.

During those years the lead-lag ballasting circuit was widely used for the various types of lamps then available. Naturally, this type of ballast gained wide acceptance in the lighting industry as the standard of ballast quality.

After the 96T12 lamp was introduced, a series ballast was developed which proved to be the best ballasting tool for this important new lamp. However, there was real hesitancy about accepting a series ballast for the 96T12 because in the past, a lead-lag ballast had been found superior for other lamps.

We felt compelled to face this challenge and advocate the series ballast for the 96T12 lamp because, everything considered, we believe it is the best ballasting tool for that lamp—giving equivalent performance in accordance with lamp specifications and offering a very substantial saving in cost and size.

The results are now known throughout the lighting industry. Millions of series ballasts for operation of 96T12 lamps at 425 ma have been furnished to the industry in the last three years by ballast manufacturers. And because series ballasts for this lamp are inherently 20% less costly—even more millions of dollars in basic ballasting cost have been saved for fluorescent lighting users.

It will continue to be our policy to use our engineering know-how and detailed knowledge of lamp requirements to produce and promote the sale of the very best ballast or selection of ballasts for every type of lamp. Whether lead-lag, series, or trigger-start, in our sincere best judgment, they will always represent the best ballast design to meet lamp and industry requirements. General Electric Company, Schenectady 5, New York. 401-4

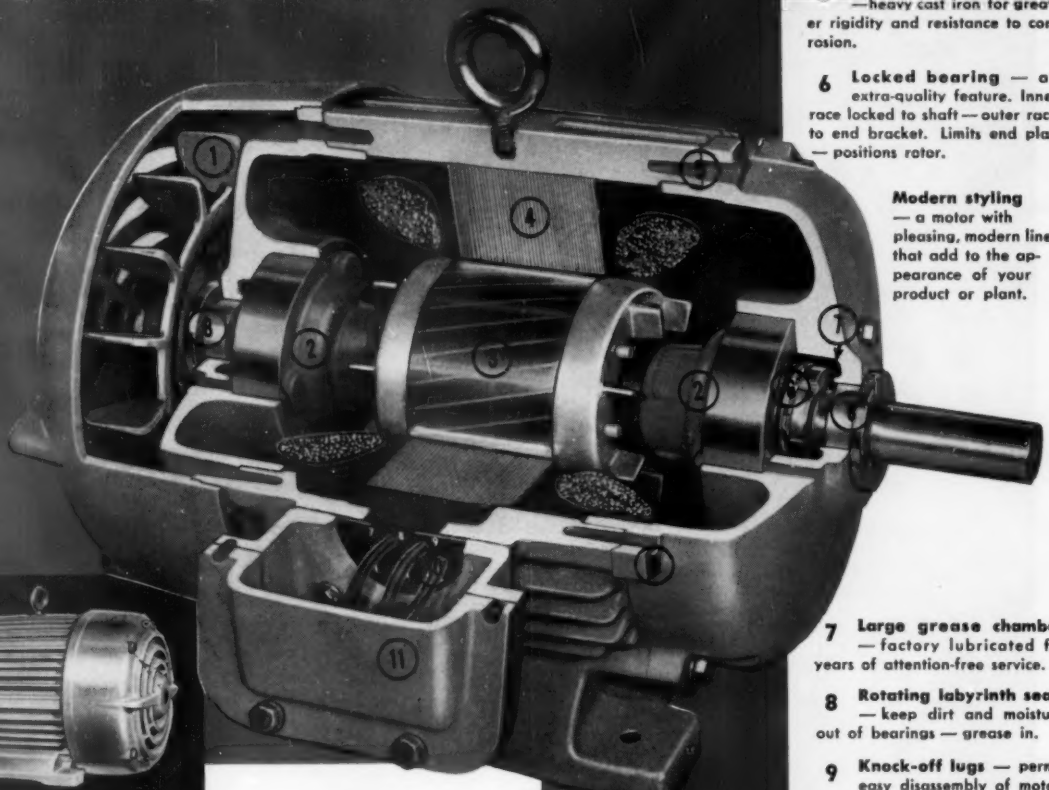
You can put your confidence in—

GENERAL ELECTRIC

Here's the inside story of

the NEW L.A. *Line*

...your BEST enclosed and explosion-proof motor BUY



1 **Fan** — efficient, non-sparking fan. New aerodynamic design for more effective cooling.

2 **Inner bearing cartridges** — lock bearings to end bracket and form explosion-quenching seal along shaft.

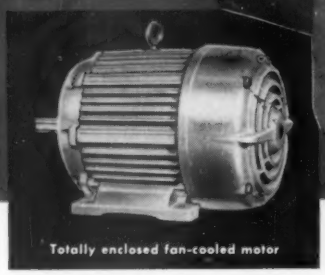
3 **Indestructable cast-aluminum rotor**—dynamically balanced with fan for smooth, quiet operation.

4 **Stator** — prewound stator core utilizes Formvar wire insulated with a new Alkyd Asphalt Resin insulating varnish.

5 **End bracket and housing** —heavy cast iron for greater rigidity and resistance to corrosion.

6 **Locked bearing** — an extra-quality feature. Inner race locked to shaft — outer race to end bracket. Limits end play — positions rotor.

Modern styling — a motor with pleasing, modern lines that add to the appearance of your product or plant.



Totally enclosed fan-cooled motor

Cutaway view of explosion-proof motor

7 **Large grease chamber** — factory lubricated for years of attention-free service.

8 **Rotating labyrinth seals** — keep dirt and moisture out of bearings — grease in.

9 **Knock-off lugs** — permit easy disassembly of motor.

10 **Lead identification**—permanent, positive lead identification spacer in conduit box.

11 **New split conduit box** — rugged cast-iron conduit box diagonally split for easy connection.

This is the completely new L.A. totally enclosed fan-cooled and explosion-proof motor. Every feature in this new line is designed for easier installation, longer service life, less maintenance and attention. You get the full benefit of the new NEMA standards in a smaller, more functional, completely modern design.

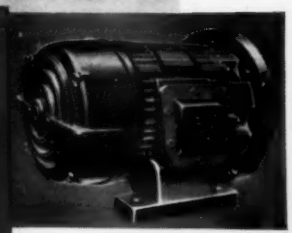
Your nearby Louis Allis Sales Engineer can show you all the reasons why these motors perform better and longer on your tough jobs — why they give you maximum resistance to corrosion wherever you need this extra protection. Call him today.

THE LOUIS ALLIS CO.
MILWAUKEE 7, WISCONSIN

LA-103

Vertical NEMA D-flange motor

NEMA C-flange motor



NEMA D-flange motor

We specialize in SPECIAL MOTORS— *and* PROMPT DELIVERY, TOO

There's a Louis Allis special motor for your toughest application. Whatever electrical or mechanical modifications you need, check first with Louis Allis.

Here's a good reason why
It's wise to buy
On over-all cost . . .
not price

I-T-E

Engineered for dependable, economical circuit protection

I-T-E Circuit Breakers protect your workers too!

Safety is a prime consideration in the purchase of any electrical protective device. The man on the machine must have the safest equipment human ingenuity can devise.

That's just *one* good reason why it pays to install I-T-E Circuit Breakers. They're *safety-engineered*—to protect your *workers*, as well as your equipment.

I-T-E Circuit Breakers are completely enclosed by insulated molded cases. They cannot be held closed against overloads or short circuits. Thus, accidents are averted.

Remember—in electrical protection, *over-all* cost is the cost that counts. Check with your local I-T-E distributor, and see how much more economical modern I-T-E Circuit Breakers really are—compared with *fusible-type* protective devices.

I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.

"TEN REASONS WHY" I-T-E CIRCUIT BREAKERS PROVIDE THE UTMOST IN MODERN CIRCUIT PROTECTION

1. They offer the highest degree of safety to personnel.
2. They reduce production down-time.
3. They eliminate replacement costs and maintenance.
4. They are completely tamperproof.
5. They are pretested to insure uniformity of operation.
6. They prevent single phasing when a fault occurs.
7. They safely carry their continuous current rating indefinitely.
8. They save mounting space.
9. They offer a wide range of special attachments and enclosures.
10. They incur low watts loss.

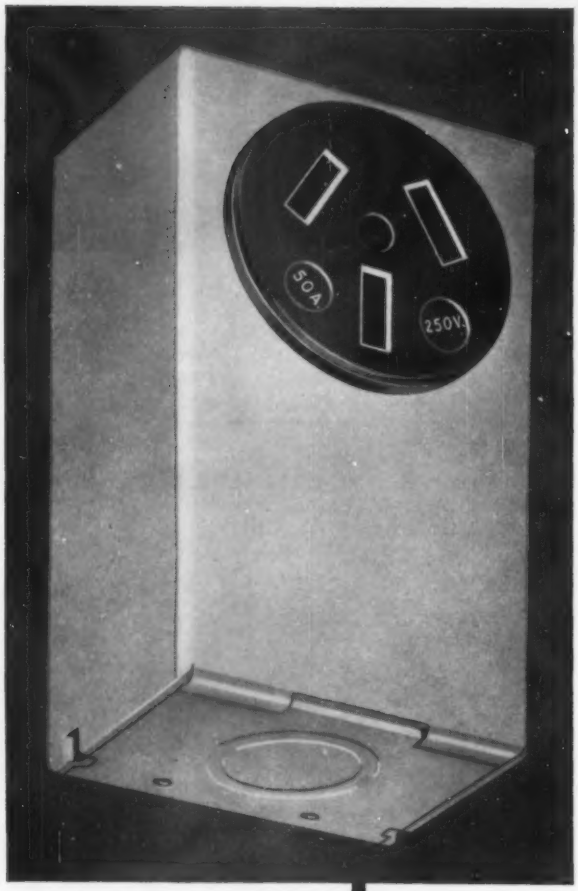
I-T-E CIRCUIT BREAKER CO.
Philadelphia, Penna.

The other side of this handy pocket card tells you how to select I-T-E Molded Case Circuit Breakers for various feeder and branch circuits. Write for card and other application data, or see your local I-T-E distributor.

I-T-E
Individually Enclosed Circuit Breakers

NEW

Range and Power Outlet with Metal Cover Bryant No. 3926



No. 3926 Surface Mounting
50 amperes — 250 volts

Aluminum cover and back plate provide maximum durability and attractive appearance to harmonize with domestic and commercial kitchen equipment.

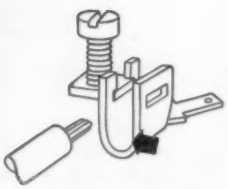
Metal construction withstands severe abuse in industrial applications.

The 3926 also offers the newly designed Pressure Terminals* for easier, faster wiring. With this feature:

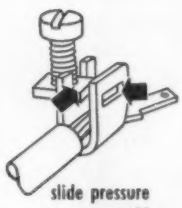
- there are no loose parts to mislay
- the screw assembly is permanently attached to the wiring channel
- rounded channel confines wire strands
- the assembly terminals are cadmium plated for either copper or aluminum wire

Specify Bryant from your Electrical Distributor. Listed by Underwriters' Laboratories, Inc.

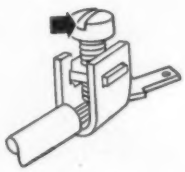
HERE'S ALL YOU DO TO WIRE THE 3926 —



lay wire in open channel



slide pressure screw assembly in opposite slot



tighten pressure screw

BRYANT
SUPERIOR WIRING DEVICES

THE BRYANT ELECTRIC COMPANY

Bridgeport 2, Connecticut

Chicago — Los Angeles

*PAT. PENDING

J-99902

Cut Plant Power Costs

...increase machine efficiency

Want to save installation and operating costs? You can do both with an Allis-Chalmers dry-type transformer.

ALLIS-CHALMERS Dry-Type Transformers

Low Installation Cost. Allis-Chalmers dry-type transformers require no expensive vaults. They are safe and clean. They fit into industrial plant layouts — they are lightweight and easy to handle.

Low Operating Cost. Routine inspection is all the maintenance you need. There are no gauges to check, no liquids to filter.

Completely Enclosed Design is standard construction on small low voltage transformers. They are recommended for indoor or outdoor applications and operate well in dusty or lint filled atmosphere. Solderless connectors speed installation. Mount on wall or post. Ratings are single-phase sizes 10 kva and smaller; three-phase sizes 15 kva and smaller, 600 volts and below.

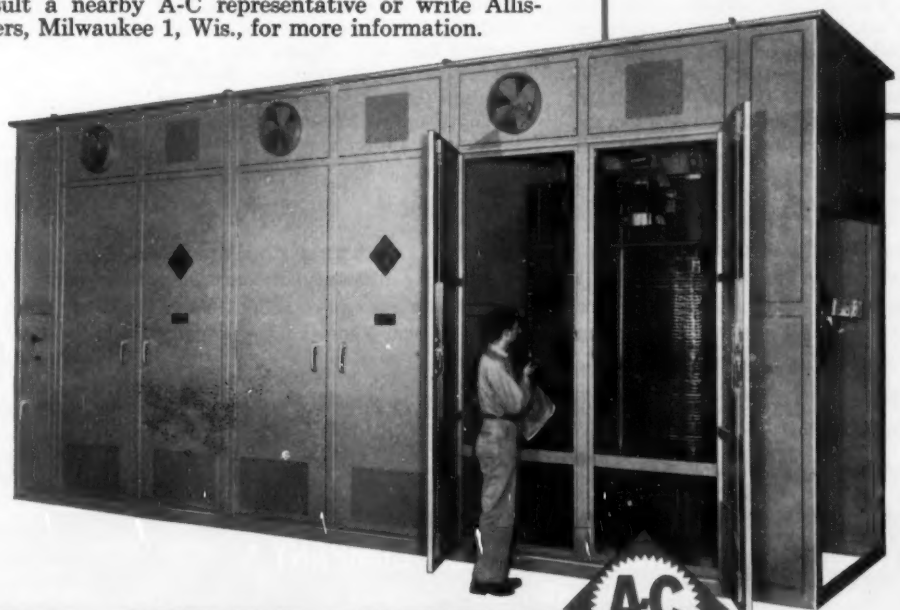
Open Ventilated Transformers are designed for indoor use. They are easy to hook up; need no special vault enclosures. They are cooled by natural or forced draft. Used as load center transformer or unit substation in the larger sizes, with high or low voltage switchgear. Ratings are single-phase sizes 15 kva and larger; three-phase sizes 30 kva and larger, 15 kv and below.

Consult a nearby A-C representative or write Allis-Chalmers, Milwaukee 1, Wis., for more information.

A-4267

10-kva dry-type transformer.

225-kva dry-type transformer.



This 10,000-kva dry-type transformer is one of a large number of units Allis-Chalmers is building for the Atomic Energy Commission.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

Meet all electrical "specs" with Youngstown Buckeye Conduit!

CONTRACTOR TELLS WHY HE'S FOR BUCKEYE: "When wiring homes, I refuse to take short cuts. That's why I use Youngstown Buckeye rigid steel conduit. That's the conduit approved for all types of building construction and occupancy—for tomorrow's demands as well as today's. Buckeye gives wiring complete protection. Home owners like to know that."

LISTEN TO THIS CONSULTING ELECTRICAL ENGINEER: "Only full weight standard threaded rigid steel conduit is approved by the Code as moisture, dust and explosion proof for use in hazardous locations. That's why I always specify Youngstown Buckeye conduit. In addition, I find that the strength and permanence of Buckeye conduit is appreciated by builders."

Youngstown manufactures full weight standard threaded rigid steel conduit from start to finish. This assures better steel and consistency of quality in manufacture. Only top grade steel gives complete long term protection. When you buy or specify Youngstown Buckeye conduit, you know you're meeting all construction requirements.

Shipments of Buckeye rigid steel conduit are now being made from our conduit mills at Indiana Harbor and Youngstown.

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

General Offices — Youngstown 1, Ohio

Manufacturers of Carbon, Alloy and Yoloy Steel

Export Office-500 Fifth Avenue, New York

COLD FINISHED CARBON AND ALLOY BARS · ELECTROLYTIC TIN PLATE · COKE TIN PLATE · WIRE · PIPE AND TUBULAR PRODUCTS · CONDUIT · RODS · SHEETS · PLATES · BARS · RAILROAD TRACK SPIKES.

NEW BENJAMIN "PANEL-GLO"

NEW BENJAMIN "SKY-GLO"

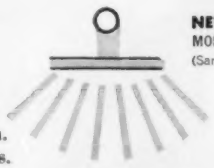
You need not forego the many advantages of a Benjamin Luminous Louvered Ceiling... comparative costs show why!

Even when you compare on the simple basis of material and fixture costs alone, it is often more economical to use a Benjamin Ceiling as against conventional individually-hung units. Especially in areas where it is desired to modernize by lowering the ceiling to cover up ugly ducts, pipes or cracks, Benjamin Louvered Ceilings are even more economical. In addition to furnishing higher light-levels, these "ceilings of light" actually modernize old-fashioned rooms to make them "look young again" without plastering or other re-decorating expense.

Send for FREE "Sky-Glo" and "Panel-Glo" Data Bulletin. Benjamin Electric Mfg. Co., Dept. H , Des Plaines, Illinois.

NEW Simplicity brings down installed price!
● New, practical, easy-to-handle 3′ x 3′ translucent panels or louver sections.

NEW, Easier installation brings down installed price!
No need to order "fill-in" size panels. Trim them yourself with scissors... right on the job... to the exact shape desired!
New metal FINISHING STRIPS neatly hide trimmed edges on either louver or luminous-panel jobs.



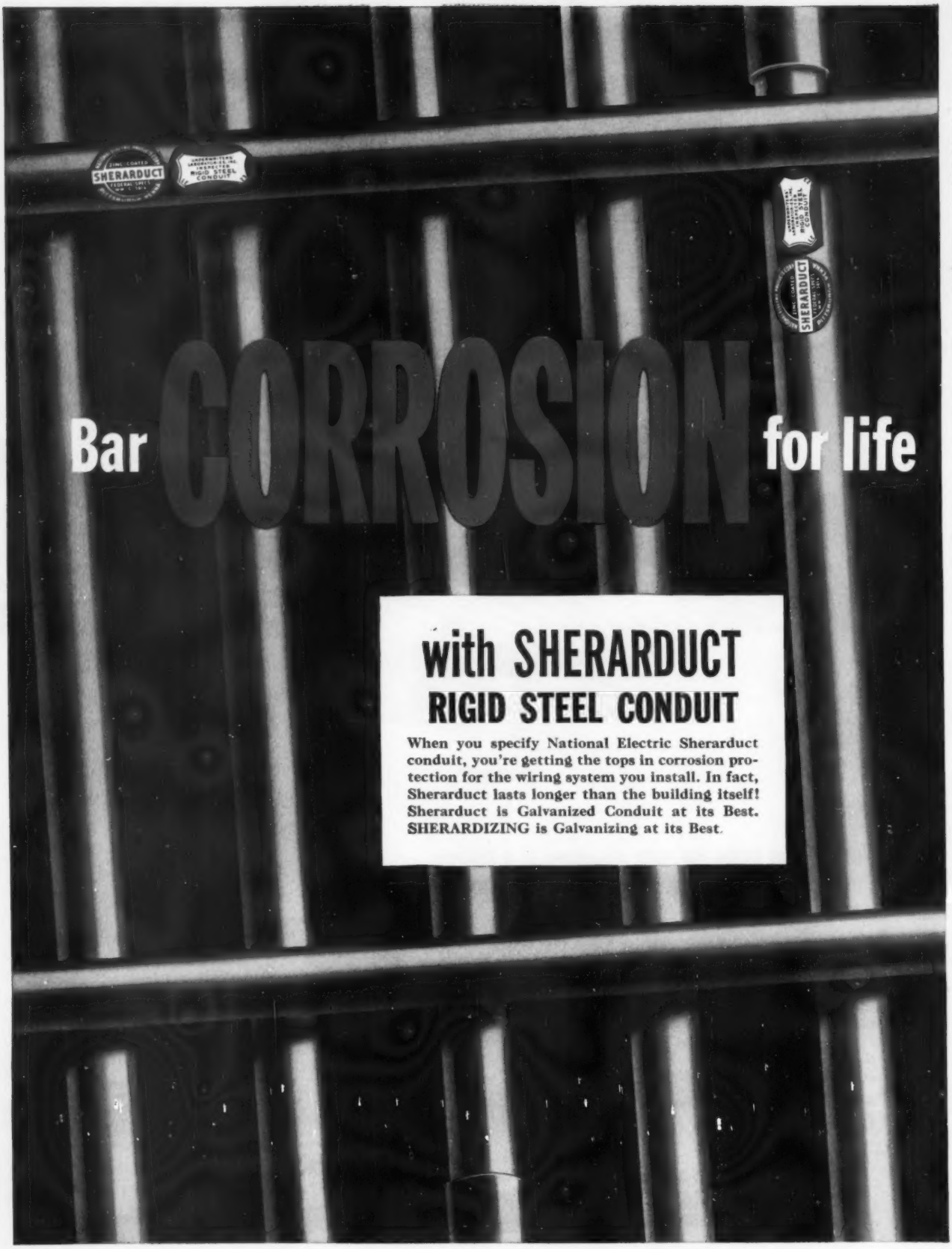
NEW, proven TRANSLUCENT plastic material means MORE LIGHT with CONTROLLED BRIGHTNESS.
(Same material used for "Sky-Glo" and "Panel-Glo.")

Benjamin "Sky-Glo" and "Panel-Glo" Ceilings are approved by Underwriters' Laboratories

NOW, figure the complete price of a ceiling-lighting job by the sq. ft.!
Sq. ft. price includes all panels or louver sections as well as all the channels, fittings, etc. you need to complete the installation!*
No calculating, no figuring.. just know the area of the room!
No layouts necessary for regularly-shaped rooms.
*lighting equipment not included.

BENJAMIN *Lighting Equipment*

sold exclusively through electrical distributors
7B-173SRR

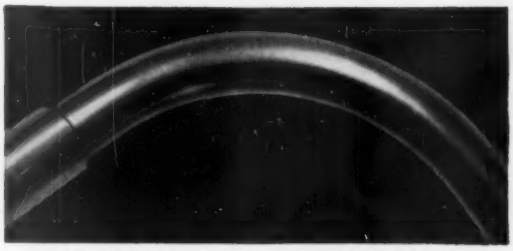

Bar CORROSION for life
with SHERARDUCT
RIGID STEEL CONDUIT
When you specify National Electric Sherarduct conduit, you're getting the tops in corrosion protection for the wiring system you install. In fact, Sherarduct lasts longer than the building itself! Sherarduct is Galvanized Conduit at its Best. SHERARDIZING is Galvanizing at its Best.

Sherarduct

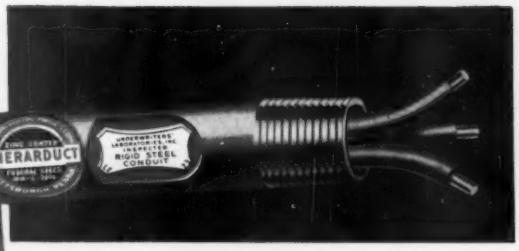
gives lifetime protection

The Sherardizing process actually alloys corrosion-resistant zinc to the steel conduit wall under heat. Thus all surfaces including the hill and valley of every single thread are provided with a 100% uniform protective zinc coating against rust and corrosion.

This is Sherardizing . . . galvanizing at its best!



Works and fishes easily . . . bends without flaking



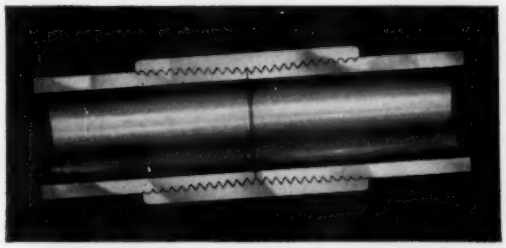
The gradual heating and cooling of the Sherardizing process normalizes the conduit steel in an annealing-like process and results in easier working, forming and bending on the job.

Conduit and couplings are threaded before galvanizing so that every hill and valley has full zinc protection.

Coupling design permits conduit ends to butt within the coupling . . . assures complete corrosion protection and is the key to a solidly locked, easily fished, thoroughly grounded electrical system.

Finally, NE's baked on Shera-enamel (inside and out) seals the zinc against acids and other corrosive agents.

This is Sherarduct . . . galvanized conduit at its best!



Coupling threads and surfaces fully zinc protected

EVERYTHING IN WIRING POINTS TO

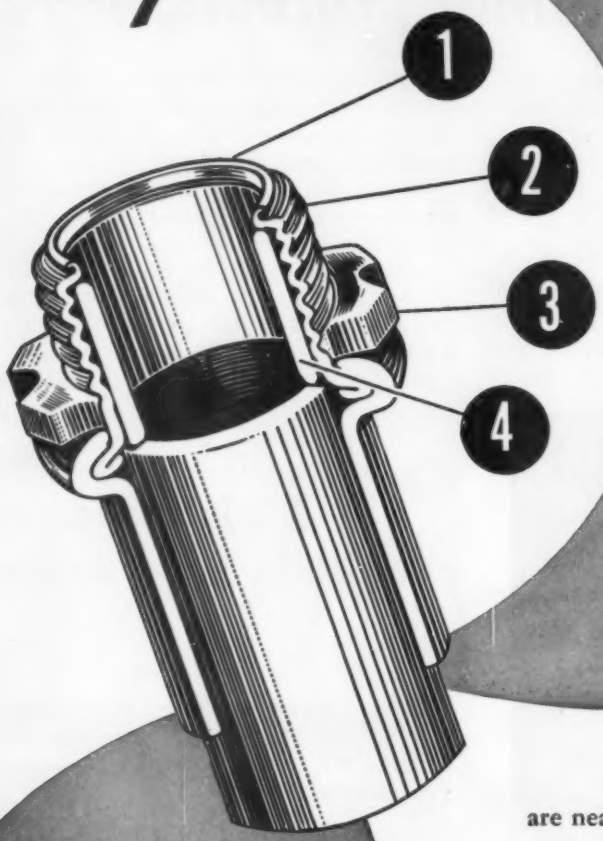
National Electric Products

PITTSBURGH, PA.

3 Plants • 8 Warehouses • 34 Sales Offices

New B-M 21 E Connector

HAS 4 OUTSTANDING FEATURES



1 Smooth Rolled Edge Throat will not cut or scrape plastic insulation.

2 Full thread screws into all conduit fittings.

3 Nut screws down flush to shoulder for positive ground.

4 Internal sleeve same inside diameter as tubing insures smooth raceway for easy fishing.

All B-M Indenter Fittings are U. L. approved as Concretetight and for General Use. (File Card E 10863)

Briegel, the Original Indenter Fittings are neater in appearance, easier and faster to use. Installation is simple and less expensive. Two quick squeezes sets them forever. Try B-M Indenter Fittings and get more profits from each job!

BRIEGEL METHOD TOOL CO.

GALVA, • ILLINOIS

Three quality tapes—friction, rubber and plastic...

If the job requires taping —it calls for ACCURATE

Make ACCURATE Electrical Tapes your choice for easier taping and positive electrical and mechanical protection. Both friction and rubber, ACCURATE tapes are strong, pliable, easier working. These quality electrical tapes are non-raveling, tear off clean, pull tight and firm ... make neat, high efficiency wraps even over irregular surfaces.

For special jobs where a reduction in bulk is essential, specify ACCURATE plastic electrical tape. Thin caliper, combined with excellent dielectric strength, make it the ideal tape for faster wiring production!

ACCURATE FRICTION TAPE
High grade carefully compounded rubber with finest cotton base provides maximum mechanical protection for every wrap. Made in Standard and A.S.T.M.

ACCURATE RUBBER TAPE
Features high elasticity, excellent cohesion, high dielectric and super aging qualities. Available in Standard and A.S.T.M.-A.A.R. grades.

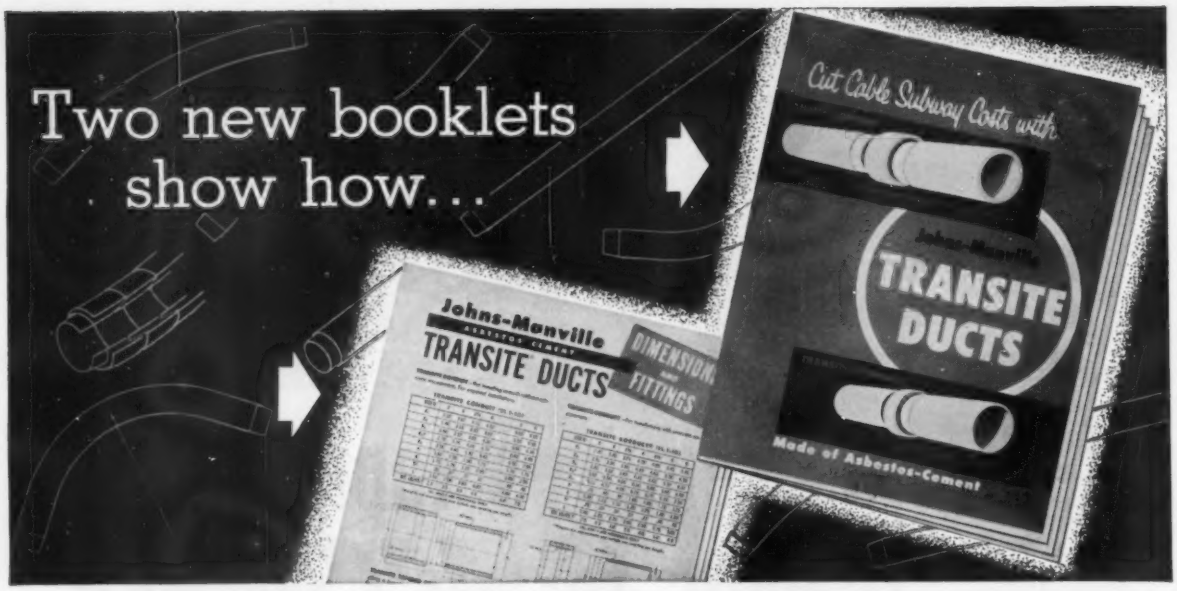
ACCURATE PLASTIC TAPE
Offers a bulk-reducing combination of thin caliper, good mechanical and dielectric strength. Recommended for use wherever plastic tape is practical.

NEW TAPE CATALOG AVAILABLE NOW!
Just call or write for the handy new Accurate catalog. A handy brochure for electricians, maintenance engineers and purchasing agents which includes all the facts on electrical tapes. Address: Accurate Mfg. Company, Garfield, New Jersey.

Specify **ACCURATE**

YOUR BEST BUY IN TAPE

MORE THAN A QUARTER CENTURY OF TAPE SPECIALIZATION



Transite® Ducts cut cable subway costs—

give greater cable protection

Transite Conduit is the thicker walled duct which is used for exposed work or is laid directly in earth without a concrete encasement. Saves time, labor and materials on the job

Transite Korduct® is the thinner walled duct for installation in concrete. Inasmuch as it is used principally for hi-voltage lines, its high thermal conductivity reduces operating losses

● Johns-Manville presents these brochures as a service to public utilities, design engineers, and all other users and planners of cable subway systems. "*Transite Ducts*" shows how improved cable subway protection, installation, maintenance and operational savings may be achieved. "*Transite Ducts, Dimensions and Fittings*" give the necessary dimensional data on all ducts and fittings.

Transite Ducts offer improved cable subway protection. Made of asbestos and cement, Transite cannot burn, smoke, fume or generate explosive gases. Transite confines arc damage and protects adjacent cables against heat and flame. Transite resists corrosive action of soils; is unaffected by electrolysis.

Installation savings result because Transite is strong, light in weight, easy to handle. It comes in long, 10-foot sections, thus, fewer joints are required. Its permanently smooth bore prevents injury to cable either from natural movement or when pulling cable through. Maintenance savings result from the permanent nature of the asbestos cement composition of Transite. It is as durable as stone.

Moreover, operational savings result because cables run cooler due to the high thermal conductivity of Transite Ducts. This also results in prolonged cable insulation life.

For complete details on how Transite Ducts can cut cable subway costs for your system, send for copies of "Transite Ducts," EL-29A and "Dimensions and Fittings," EL-45A. Write to Johns-Manville, Box 60, New York 16, New York. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE DUCTS

TRANSITE KORDUCT—for installation in concrete

TRANSITE CONDUIT—for exposed work and installation underground without a concrete encasement

when the finest in lighting is installed...

Installations like these the country over vary greatly as to size, pattern, shielding, intensity and periphery. But they all have these things in common: superb quality of illumination and *ease, simplicity and economy of installation.* **That's why electrical contractors the country over are finding in Smithcraft Area Illumination a source of excellent new profits and a source of pride and business-building prestige in the installation of today's finest lighting.**

Reading from left to right, starting at top:

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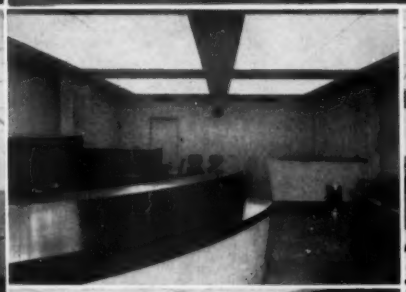
Owens-Corning Fiberglas Corp., Ashton, Rhode Island
Ford Motor Company, Dearborn, Michigan
Melbourne National Bank, Melbourne, Florida
Niagara Mohawk Power Corp., Syracuse, New York
Rawding Electric Company, Beaver Falls, Pennsylvania
Texas Eastern Building, Shreveport, Louisiana
Mount Healthy-Saving and Loan Company, Mt. Healthy, Ohio
Van Huffel Tube Corporation, Warren, Ohio
Florida Power and Light Company, Sanford, Florida

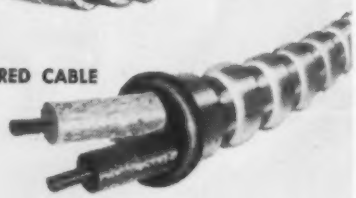
smithcraft **area** *illumination*



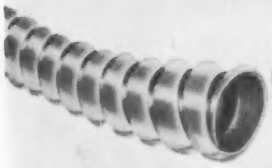
Smithcraft
LIGHTING DIVISION
CHELSEA 50, MASSACHUSETTS

and make sure it's Columbia

NON-METALLIC SHEATHED CABLE



A.B.C. ARMORED CABLE



FLEXIBLE STEEL CONDUIT

T W

E. M. T.

This electrician is specifying Columbia Cable, Wire, and Conduit. And for good reason.

From experience, he knows that Columbia products are easily installed . . . easy to work with. Take your cue from the man on the job . . . he knows . . . make your next installation Columbia and see!

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Send for Columbia Electrical Data Guide Book

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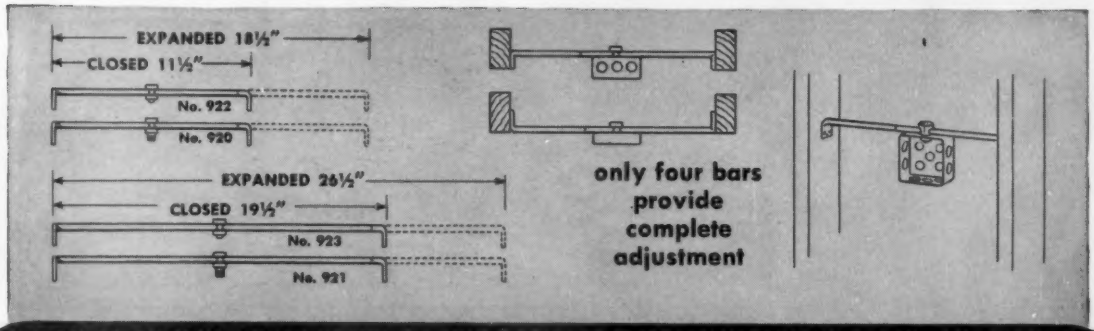
the first adjustable bars that fill every requirement... pass every test!

ONLY 4 BARS ENABLE YOU TO INSTALL ANY DEPTH BOX WHEREVER YOU WANT IT REGARDLESS OF STUDDING SIZE OR SPACING

STOCK JUST 4 BARS INSTEAD OF 16



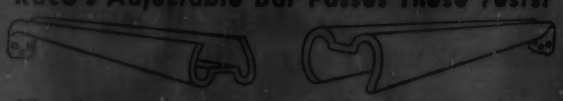
NORMAL SAFETY PRECAUTIONS REQUIRE THAT A BAR MUST WITHSTAND THESE TESTS

1. Direct pull on stud of 200 pounds for 5 minutes.

2. Six rotations of a 30 pound pull, 20" away from stud at a 30° angle in one minute.

3. A torque of 20 pounds at 20" horizontally from stud for one minute.

Raco's Adjustable Bar Passes These Tests!



There is strength to spare due to these special formations!

Use Raco's New Clip or Popular Stud!

The new Raco Clip uses a strong new saddle of 13 gauge steel, formed steel clip and short, strong No. 14-20 round head screw.

Popular Raco Stud uses the same saddle, a formed 13 gauge steel stud with six full, deep No. 20 threads and a stout No. 14-20 screw.

Raco Clip provides ample room for device and added wiring space in any type box.

WRITE TODAY • get complete information on Raco Bar Hangers

YOU CAN ALWAYS DEPEND ON RACO

ALL-STEEL EQUIPMENT INC. Aurora • Illinois

Facts you should

Rome Aluminum Triplex offers savings up to 30% and better

Here is one of those rare opportunities for you to save real money, yet get maximum performance and improved appearance.

You save up to 30% and better over conventional Type SD service cable when you install Rome Aluminum Triplex Service Drop and Secondary Cable.

First you save on initial cost. Then you save time on installation because of lighter weight and less handling. For secondaries that means you can string longer spans with fewer poles. It is possible to use mid-span taps. You may eliminate crossarms, messenger rings, and use a minimum of hardware.

You save, too, on maintenance and service interruption because Rome Aluminum Triplex offers maximum resistance to storms, wind and ice loading as well as other exposure elements.

Its RoPrene (Neoprene) or RoLene (polyethylene) insulations protect against sunlight, heat, moisture, corrosive atmospheres and other operating hazards. There are no braids to rot or festoon. Conductors are more accessible because they have no common covering.

Better Performance

In addition to savings, you get better voltage regulation because of lower reactance in long and heavily loaded circuits. And finally you have a neater, cleaner installation... no cluttered, unsightly open wires.

For full information on Rome Triplex with copper or aluminum conductors send for Rome Bulletin RS-5 which gives specifications, dimensions, sag and tension data, and installation tips.

New 500-foot carton makes handling easier

Rome Aluminum Triplex can now be purchased in handy cartons of 500-ft. coils. Carton size assures easy storage and handling. Center knockout simplifies cable removal. This cable is also still available on 1,000-ft. reels.

know about Rome Aluminum

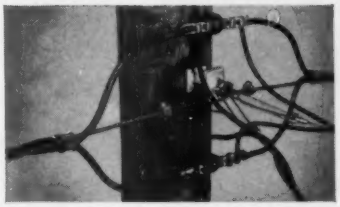
Tips on Connecting Aluminum

1. Clean surface of aluminum conductors thoroughly before making connection.
2. Use a liberal coating of compound on all joints and connections.
3. Do not use solder for joining conductors — pressure-type connectors are preferable.
4. Connector material should be aluminum or aluminum alloy. Where aluminum to copper connections are involved, a copper or copper-alloy insert permanently bonded to the over-all aluminum connector has proven generally satisfactory.
5. Protect finished joints from air and weathering by covering with compound, or other suitable material.

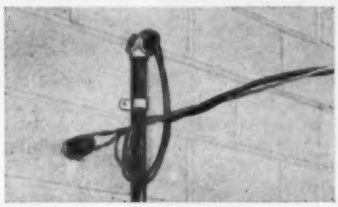
New Rome ACSR provides dependable operation

If you are planning new overhead distribution lines, it will pay you to specify Rome ACSR. Carefully controlled manufacture and testing of this product assure exceptional uniformity and dependability.

Typical service connections



Typical service tap connection at pole.



Typical dead end connection at house.

Fewer poles, longer spans with mid-span taps possible on secondaries.

Weatherproof Wire

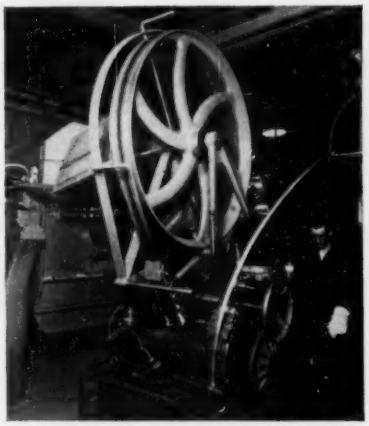
Regularly supplied with solid or stranded all-aluminum or ACSR conductors, covered with RoLene or RoPrene. Conventional URC triple braid covering can also be supplied.

New spin-casting wheel helps assure controlled methods

Rome Cable is one of the few manufacturers of aluminum conductors to use the famous Properzi casting wheel.

Molten aluminum is transferred to the casting wheel. Flowing in the groove of the wheel, sealed by a continuous band, the solidified aluminum emerges as a triangular cast shape.

A casting method such as this, plus careful, scientific compounding and application of insulating materials, permit Rome to control the quality of its aluminum products throughout every step of their manufacture.



In addition, thorough chemical and metallurgical research, plus extensive testing that is independent of production and sales, are your assurance of safety and long-lasting economy when you specify Rome aluminum wires and cables.

Send for your copy of Bulletin RS-5 on copper and aluminum self-supporting service drop and secondary cables.

It Costs Less to Buy the Best

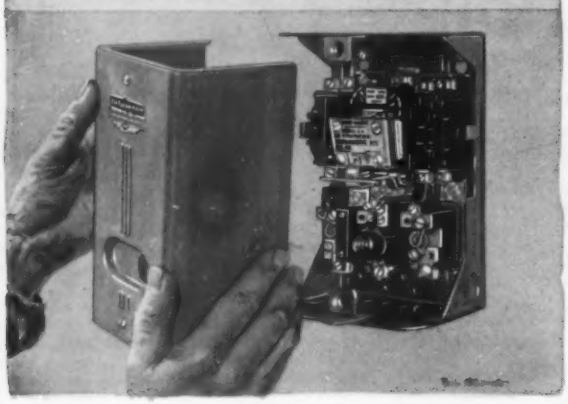
Rome ALUMINUM

ROME CABLE CORPORATION, ROME, N.Y., AND TORRANCE, CALIF.

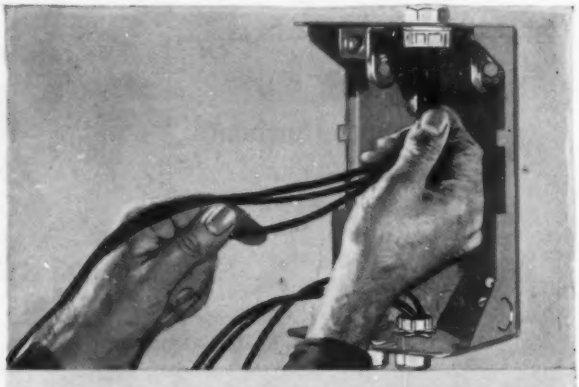
HE THREE CUTLER-HAMMER STARS ★ ★ ★ STAND FOR THREE NEW STANDARDS

☆ installs easier
☆ works better
☆ lasts longer

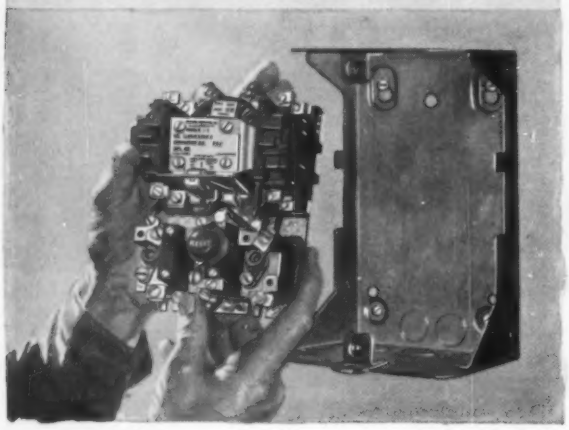
1. Just loosen two screws . . . and off comes wrap-around cover. Screws stay in cover, do not fall into machines or get lost on floor; a typical time-saving design detail.



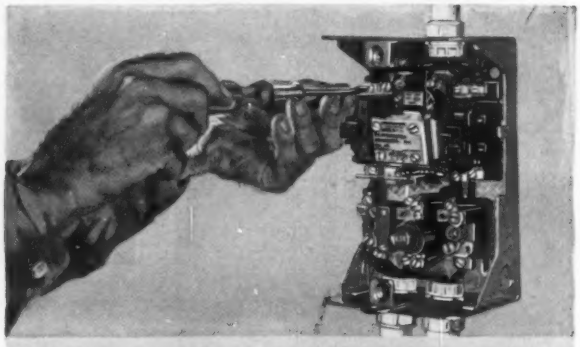
3. Pull in wires . . . Making conduit connections and pulling wires is a cinch. No starter mechanism or side walls of case in the way. No skinned knuckles or damaged starters.



2. Remove entire starter mechanism . . . by merely loosening three screws. Then light, easy-to-handle skeleton case can be installed. Embossed mounts for good job on uneven surfaces. And upper mounting holes are keyhole slotted.

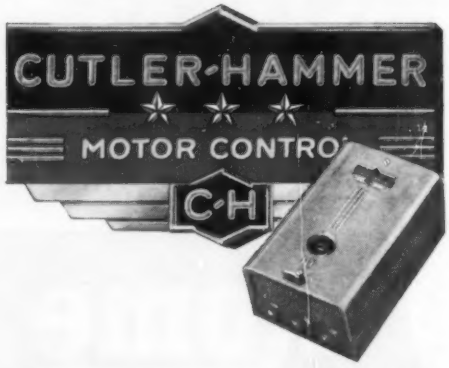


4. Connect up and go . . . Straight-through wiring; all line terminals at top, load terminals at bottom. All terminals are clearly marked and visible from front. Pressure connectors throughout. All panel wiring is color coded.



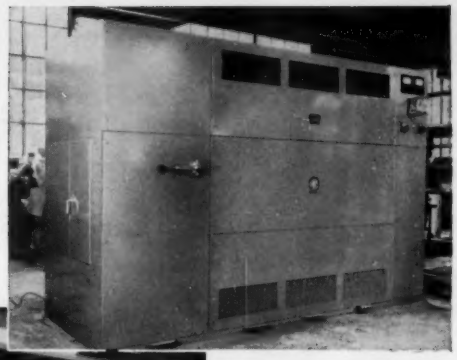
Factory records everywhere today show the cost of installing motor control is almost always greater than the cost of the equipment, often two to three times as much. That is why Cutler-Hammer engineering made easier installation a key objective in designing the new Cutler-Hammer ☆ ☆ ☆ Motor Control. When you buy motor control, figure its *real* cost, its installed cost. Then you too will insist on Cutler-Hammer! Your nearby Cutler-Hammer Authorized Distributor is ready to serve your needs. Order from him today.

CUTLER-HAMMER, Inc. 1306 St. Paul Ave., Milwaukee 1, Wis.



CUTLER-HAMMER ★ ★ ★ MOTOR CONTROL

MARCUS dry type TRANSFORMERS are insulated with NATVAR SPECIAL INSULATION



This trim, compact cabinet houses a Marcus 2000 kva., 4800-480 volt, 3 phase, 60 cycle, dry-type transformer which will supply intermediate AC power to a bank of selenium rectifiers in a large West Coast metal reduction plant.

This interior view shows the rugged construction of Marcus industrial unit substations. A Natvar special combination of Quinorgo® firmly bonded to varnished open-weave Fiberglas provides a flexible insulation of high dielectric strength and great mechanical toughness, plus the ability to withstand continuously high operating temperatures. It is used as a layer insulation for the major insulation barrier between primary and secondary, and between core and coils.

Marcus Transformer Co., Inc., Hillside, N. J. manufactures dry-type transformers from 1 to 3000 kva. capacity, engineered for long life and continuous, trouble-free service.

All materials used in their construction are carefully chosen for durability and performance under maximum loads at high temperatures. A Natvar special combination of Quinorgo® and Fiberglas firmly bonded together is used because of its exceptionally good electrical properties, flexibility, mechanical strength, and its ability to withstand heat.

Whether your requirements call for a standard insulating material, available either from your wholesaler's stock or direct from our own, or a special combination, it will pay you to investigate Natvar flexible insulations.

Natvar

Natvar Products

- Varnished cambric—cloth and tape
- Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglas
- Varnished papers—rope and kraft
- Slot cell combinations, Aboglas®
- Varnished-lacquered tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

Ask for Catalog No. 22

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

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CABLE ADDRESS NATVAR: RAHWAY, N. J.

205 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

"I used a lot of REPUBLIC "INCH-MARKED" E.M.T. on this job,"

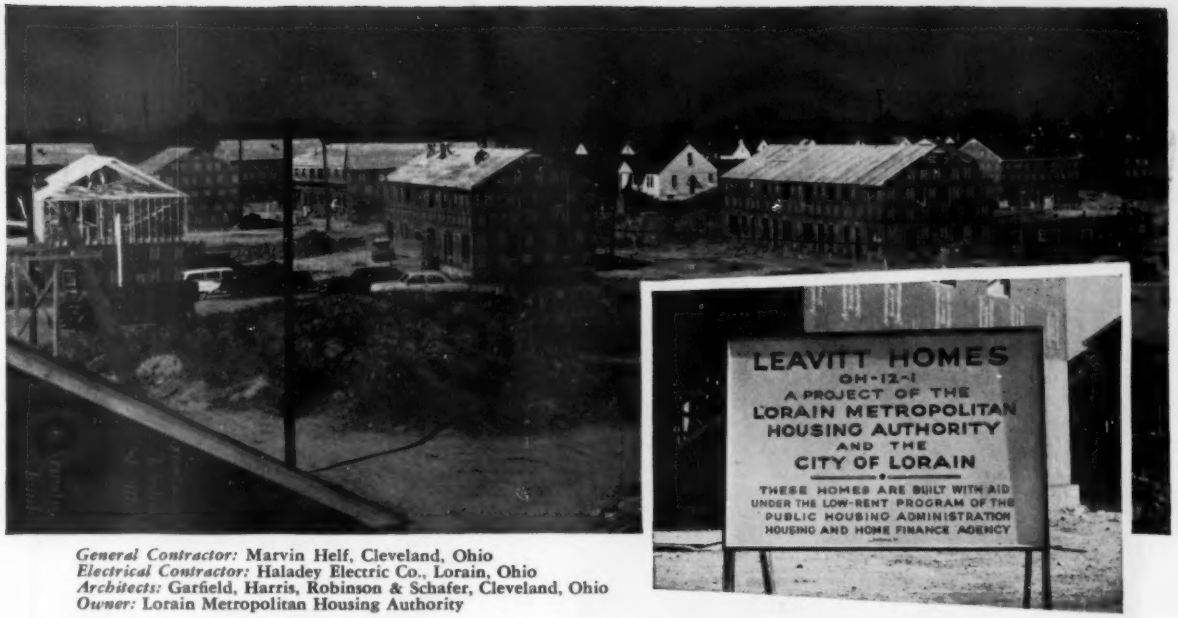
says contractor

Architects prefer holes drilled in supporting members instead of notching, which weakens them. With ELECTRUNITE E.M.T., it's easy to insert the tubing and make tight joints because it's unnecessary to turn the whole run.

No fumbling around inside the box when you use ELECTRUNITE E.M.T. The connector can be inserted before the box is put in position. The nut is then easily tightened from the outside.

Inside-Knurling, an exclusive ELECTRUNITE feature, takes much of the strain out of wire-pulling. Tests show this "ball-bearing" surface makes wire-pulling up to 30 per cent easier.

To make smooth, accurate bends, easily, all you use is the one-piece calibrated bender together with the inch-marks on the ELECTRUNITE E.M.T. The bender can be used either in waist-high position or on the floor to make stubs accurately to measurement.



General Contractor: Marvin Helf, Cleveland, Ohio
Electrical Contractor: Haladey Electric Co., Lorain, Ohio
Architects: Garfield, Harris, Robinson & Schafer, Cleveland, Ohio
Owner: Lorain Metropolitan Housing Authority

No lines to turn in close or awkward places when you're using ELECTRUNITE E.M.T. And since every coupling is a union, it's easy to make tight joints. This is only one of many ways you save with ELECTRUNITE E.M.T.

Easy does it when you use ELECTRUNITE E.M.T. No messy threading to do. And you measure the distance, not the tubing, then cut with a 32-tooth hacksaw. Look for the ELECTRUNITE label that means you also get the Underwriters' Seal of Approval.

WHEN Electrical Contractor Bob Haladey ordered conduit for the 200-suite Leavitt Housing Project, Lorain, Ohio, he specified much of it Republic ELECTRUNITE, the "Inch-Marked®" E.M.T.

"It has all the advantages I want," says Haladey. "My men like it, too. They can make smooth, accurate bends using the 'inch-marks' on the tubing along with the Republic Bender. And since we've been using this Republic Bending System, we don't get any 'wows'. Republic E.M.T. goes in easy, and we get a nice clean job. Circuits are well grounded, too, and they get the protection of steel against damage."

Many other contractors feel the same way about Republic ELECTRUNITE E.M.T. If you haven't tried it yet, next time you call your distributor, ask for Republic, the "Inch-Marked" E.M.T. Booklet SA-54 will give you the facts about this lightweight, economical threadless steel raceway. Write for it.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
203 E. 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

"INCH-MARKED®"

THE MARK OF QUALITY

Republic

REPUBLIC STEEL

ELECTRUNITE E.M.T.

case history

no oil migration

This series of Okolite-Okoprene equalizer bus ties is installed in the Cincinnati Gas and Electric Company's West End Station. One of the reasons for choosing this cable design for vertical runs is that it eliminates oil migration problems inherent in varnished cambric and paper-insulated constructions. This feature is just one reason why today's best buy in high voltage cables is Okolite-Okoprene.

WHY THEY'RE SWITCHING TO OKOLITE
rubber-insulated cables for use up to 35,000 volts

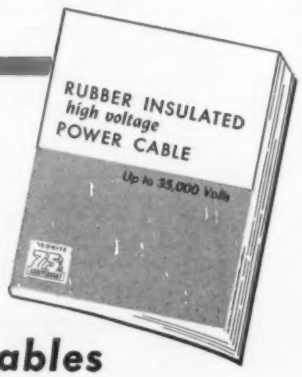
There is a distinct trend among industrials and public utilities toward Okolite rubber-insulated cables for high voltage use.

ADVANTAGES

1. **Lighter and easier handling.**
2. **Eliminates sheath corrosion and fatigue.**
3. **Simplifies splicing and terminating.**
4. **Moisture does not affect the insulation.**
5. **No oil migration at high temperatures or elevations.**
6. **Flexibility simplifies installation.**

APPLICATIONS

1. **Transmission and distribution circuits.**
2. **Generator and transformer leads.**
3. **Vertical risers and shaft cables.**
4. **Submarine power cables.**
5. **Portable substation cables and test leads.**
6. **X-ray cables.**



Send for this 128-page manual on rubber-insulated high voltage cable. It provides current carrying capacity tables, dimensional data, engineering information and installation procedures, complete instructions and detailed drawings for splices and terminations. Write for Bulletin EC-1075 on your letterhead to The Okonite Company, Passaic, New Jersey.

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1871

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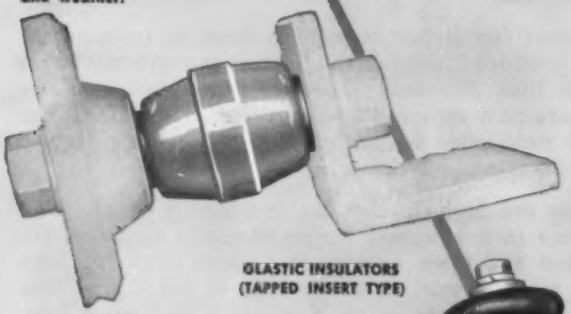
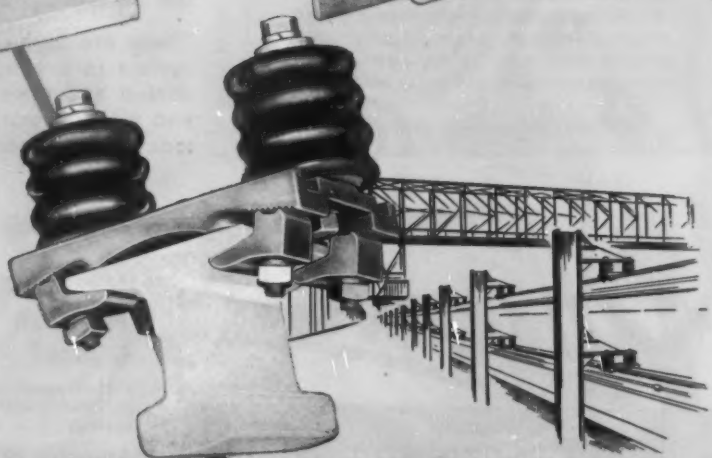


GLASTIC INSULATORS (TAPPED INSERT TYPE)



Basic units shown have great variety of application by use of proper fittings, selected from our Industrial Catalog. Write for illustrated folder.

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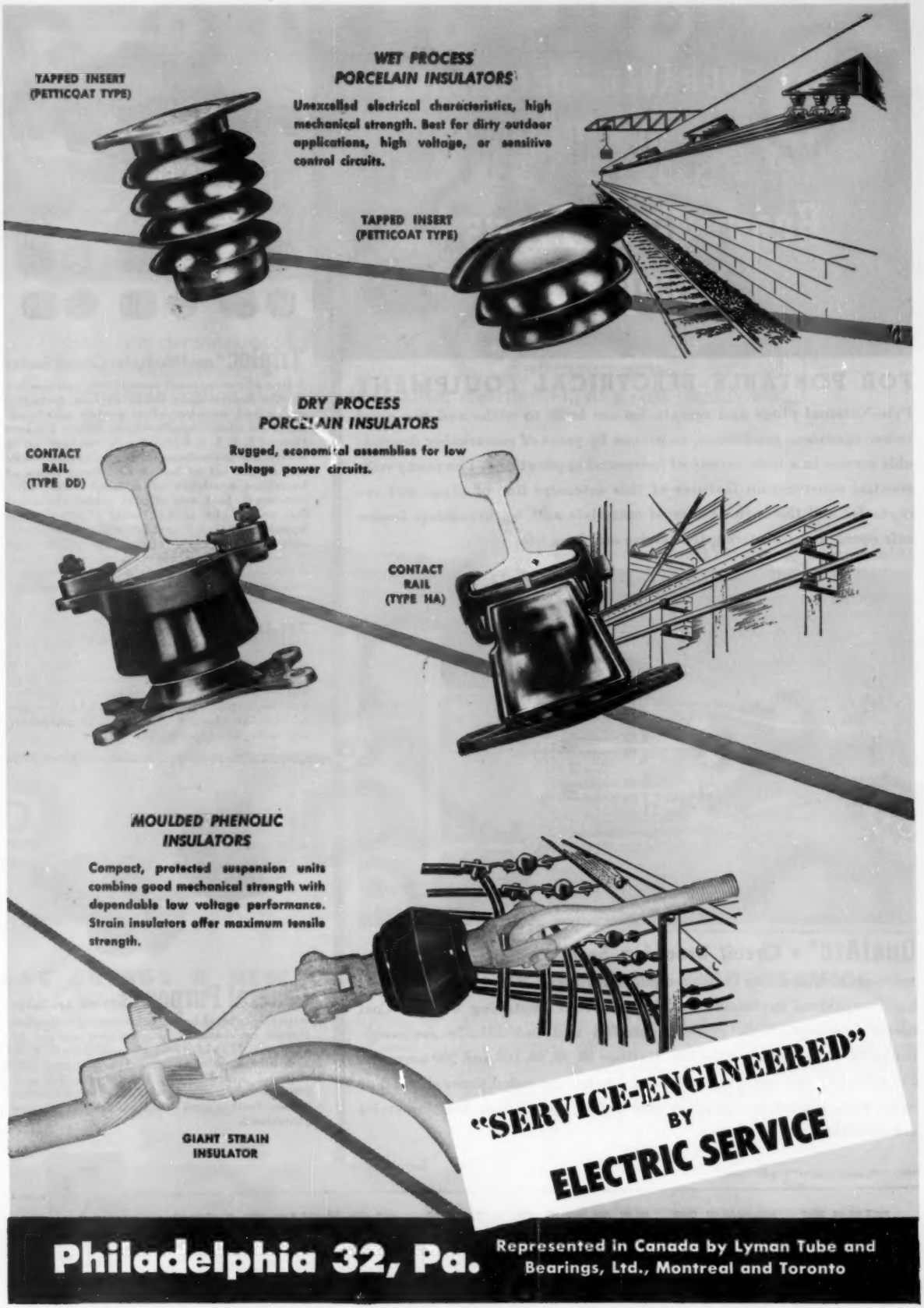
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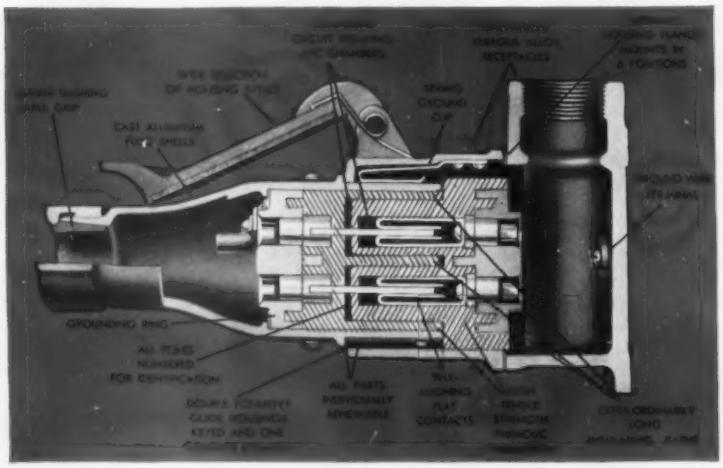
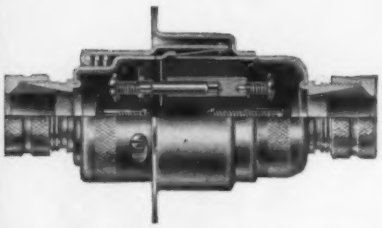


QuelArc* • *Circuit Breaking Series* **Unique partitioned insulation provides long insulated paths through air and across surfaces for exceptional protection in these current rupturing devices. Cast metal housings, high grade insulation and individually renewable contacts insure long service life. Ratings 20, 30, 60, 100 and 200 amperes, 250 volts DC, 600 volts AC—2, 3, and 4 pole—grounded through shell or extra pole. Threaded cap, plain and hinged spring door housing styles are available.**

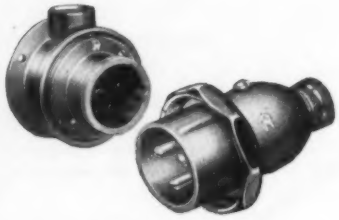


Interchangeable reversible contact units. 1, 2, 3, 4, 6, 8 and 12 pole

Triploc* *and Multiple-Circuit Series*

A line of exceptional versatility, unequalled in the heavy duty field, with a virtually unlimited number of assembly combinations for varied applications. Offers a selection of 1, 2, 3, 4, 6 and 8 pole contact units which are interchangeable and reversible in any single set of housings. Many types of housings available of pressed steel with automatic lock and of cast metal threaded for watertight gasket seal. Multi-Circuit housings with 2, 3 and 4 contact units available for combinations up to 32 poles. Ratings 15 and 20 amperes, 250 volts DC, 460 volts AC—circuit breaking. Pressed steel fusible and fuseless plugs measure only 1 13/16" outside diameter.

Midget Triploc* *Series* **Same construction features as Triploc except for much smaller outside diameter of plug shell—only 1¼". Interchangeable and reversible contact units—2, 3 and 4 pole—are of the flat blade type. Rated 10 amperes, 250 volts; 15 amperes, 125 volts.**



General Purpose *Series* **Available with cast metal housings in many types for circuit breaking and disconnect service. 30 amperes, 125 volts DC, 250 volt AC—1, 2, 3, 4, 5 and 6 pole. 60 amperes, 250 and 600 volts—3, 4 and 5 pole. 100 ampere, 250 and 600 volts—2, 3 and 4 pole. Also many special types, fusible and fuseless, for varied applications.**

*TRADEMARK REG. U. S. PAT. OFF.

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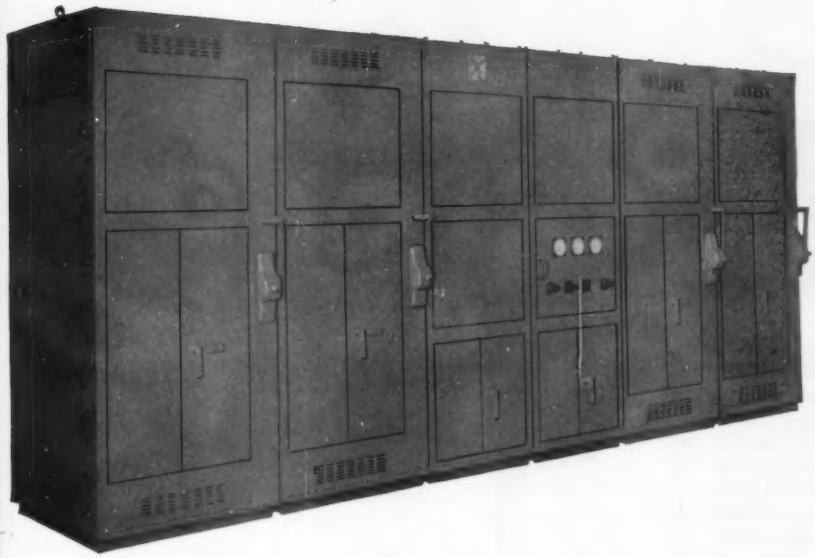
S&C has demonstrated time after time that expensive circuit breakers are usually unnecessary in switching centers. S&C Switchgear serves every needed purpose in high voltage industrial power distribution, at a cost usually about half that of circuit breakers.



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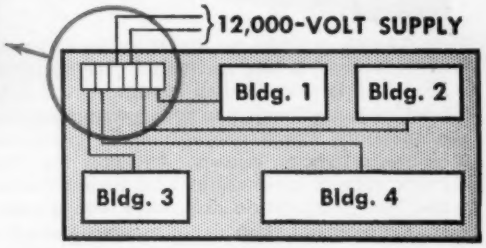

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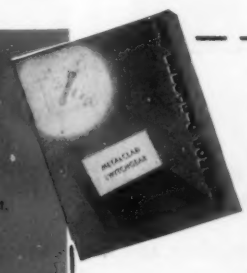

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improved with new one-piece phenolic case

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model 1010
10A "T" 125V

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all are McGILL® quality

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Colored plastic levers

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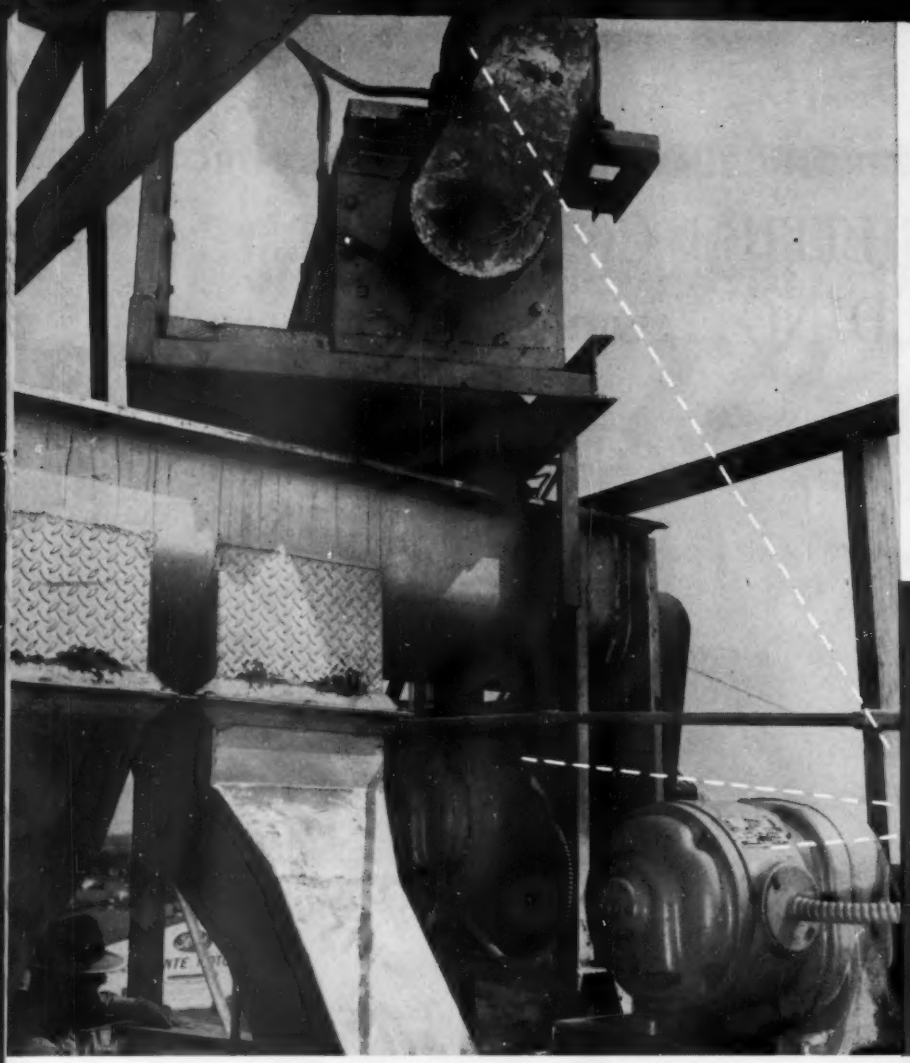

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Roebling ROEPLASTIC Control and Signal Cables are ideal for such purposes as remote control of motors, switch gear, automatic machinery, etc.... for traffic light control, relay, metering and supervisory circuits. They are made in constructions, types of insulations and over-all sheaths to meet every specific requirement. Write for technical data... and order ROEPLASTIC Control and Signal Cables from your Roebling distributor. John A. Roebling's Sons Corporation, Trenton 2, N. J.

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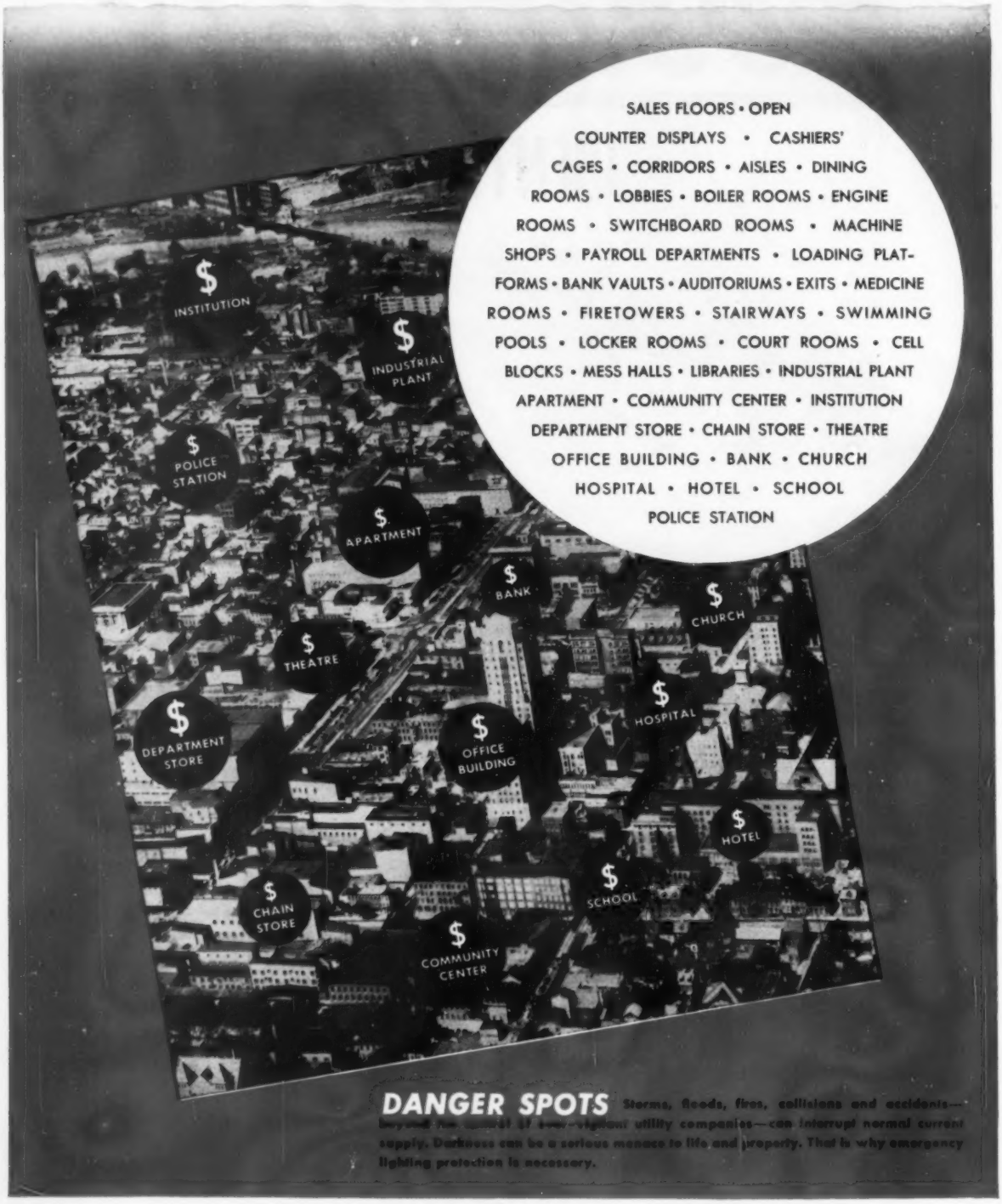
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DANGER SPOTS Storms, floods, fires, collisions and accidents—beyond the control of even vigilant utility companies—can interrupt normal current supply. Darkness can be a serious menace to life and property. That is why emergency lighting protection is necessary.

FOR EMERGENCY LIGHTING...

profits for dealers

There are hundreds of money-making opportunities all around you to sell Exide Lightguard emergency lighting protection! YOU can cash in as a dealer . . . quickly build extra profits for yourself. Every public gathering place needs emergency lighting—needs the protection of Exide Lightguard: Factories, Schools, Hospitals, Theatres, Restaurants, Hotels, Stores and markets, Banks, Police Stations. *And as many as 200 Exide Lightguard units are deemed necessary by some industrial plants!* The potential is tremendous!

Exide Lightguard units are needed everywhere! Your prospects want the dependable protection of Exide Lightguard . . . because they know emergency lighting can prevent personal injury, property damage, pilferage. So sell them what they want—sell them Exide Lightguard!

The new Exide Lightguard units are two important and timely developments. Timely, because emergency lighting provisions now are required by law in many cities and states. Important, because emergency lighting is a vital factor in civil defense programs. The new units permit standardized installations meeting all specifications, whether defined by national and state codes or by local ordinances.

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Exide Batteries of Canada, Limited, Toronto
"EXIDE" and "LIGHTGUARD" *Reg. T.M. U.S. Pat. Off.*
1888...DEPENDABLE BATTERIES FOR 66 YEARS...1954

Model M Lightguard. Double lamp unit.

MAIL THIS MONEY MAKING COUPON NOW!

Model T Lightguard. Double lamp also available.

Model M Lightguard. Single lamp unit.

EXIDE LIGHTGUARD—A portable, low cost unit that combines unprecedented long service life, low maintenance, with excellent discharge characteristics. Unit can be plugged into any A.C. lighting outlet. When normal supply of current fails, a built-in relay instantly and automatically turns on the powerful floodlight. After normal service is restored, the relay shuts off floodlight and returns battery to charge. The Exide battery, specifically designed for emergency lighting service, is always ready for immediate action.

ATTENTION, CONSULTING ENGINEERS—To meet specific requirements of fixed installations, higher voltage Exide emergency light and power equipment is available to meet a wide range of conditions. Exide engineers will be glad to help with your problems.

THE ELECTRIC STORAGE BATTERY COMPANY
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ADDRESS.....

CITY.....STATE.....

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Light on an old banking problem

BRIGHT and friendly is the interior of this bank since it was given new life with properly designed lighting. Though the soaring ceiling presented a problem, Litecontrol engineers solved it with incandescent lens boxes. These fixtures blend smoothly into the architectural design — give a narrow concentrated beam that easily bridges the gap between ceiling and floor. Certainly an excellent solution to the old problem of relighting older style buildings.

Shown is the Merchants National Bank, Salem, Massachusetts

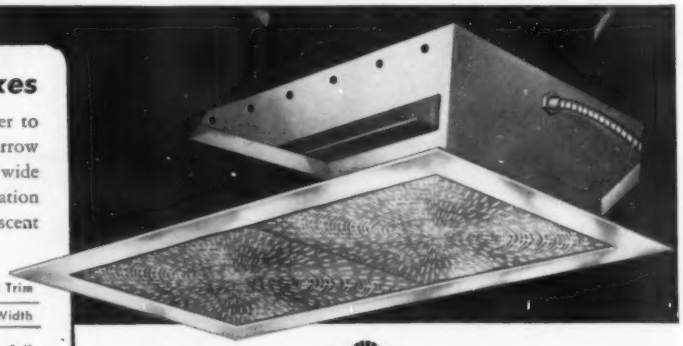
Architect, W. H. Jones & Son, Melrose, Mass.; Engineer, John R. McVey, Salem Electric Lighting Company; Electrical Contractor, Wilson & Robinson; Distributor, DesRoberts Electric Supply Company. Ceiling height: 24½ feet. Fixtures: 24, 2 gang recessed lens boxes for top service with Holophane #1765 lens-reflector combination. Designed for 300 watt incandescent lamps to provide an average of 35 footcandles in service in work areas.

...with Litecontrol Lens Boxes

These Litecontrol flush lens boxes can be the answer to many of your lighting problems. Use them with "narrow beam" lens and reflector combinations or with "wide beam" combinations. Be sure and write for information on the many other types of fluorescent and incandescent fixtures manufactured by Litecontrol.

Catalog Number	Lamp Wattage	Roughing Box			Exposed Trim	
		Length	Width	Depth	Length	Width
12F-V30-2	2-150†-300	25"	12⅞"	11¼"	27"	14⅞"
*12F-V30S-2	2-150†-300	25"	12⅞"	11¼"	27"	14⅞"
12F-V30-3	3-150†-300	37"	12⅞"	11¼"	39"	14⅞"
*12F-V30S-3	3-150†-300	37"	12⅞"	11¼"	39"	14⅞"
12F-V30-4SQ	4-150†-300	26"	26"	12"	28"	28"
*12F-V30S-4SQ	4-150†-300	26"	26"	12"	28"	28"

*Supplied with Holophane Square Reflector for wide beam spread.
†Use ⅞" Socket Extension. Note all these boxes available with top service for relamping from above.



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Fixtures
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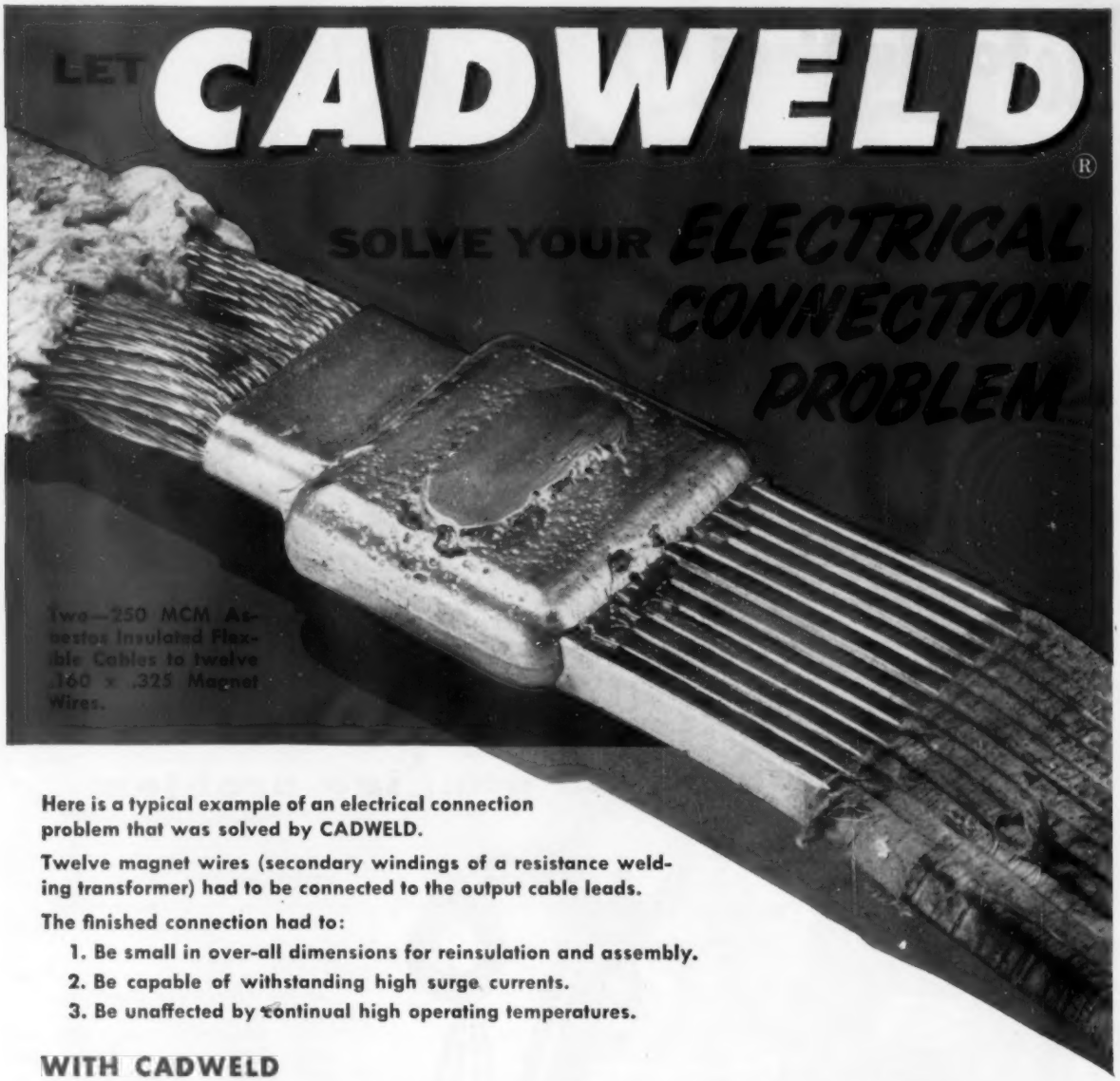

Here is a typical example of an electrical connection problem that was solved by CADWELD.

Twelve magnet wires (secondary windings of a resistance welding transformer) had to be connected to the output cable leads.

The finished connection had to:

1. **Be small in over-all dimensions for reinsulation and assembly.**
2. **Be capable of withstanding high surge currents.**
3. **Be unaffected by continual high operating temperatures.**

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1. **Any shape or size conductor (copper or steel) can be connected with standard equipment.**
2. **Connections have current carrying capacity equal to that of the conductor.**
3. **Connections cannot loosen or corrode.**
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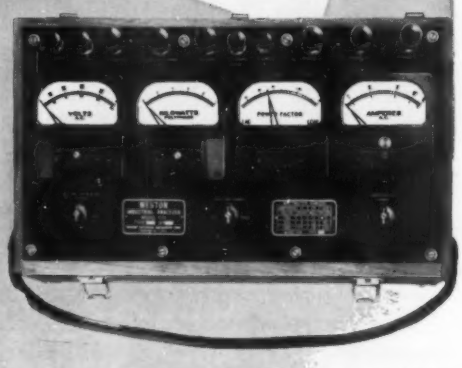

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A real timesaver because only one hook-up is necessary to measure a-c current, voltage and power in single and polyphase circuits, as well as power factor in 3 phase, 3 wire, balanced circuits. Adequately insulated binding posts . . . high overload capacity. Furnished in compact oak carrying case measuring only 18⅞" x10⅞"x6⅞".

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Especially designed for checking electronic control and power equipment. Seven d-c voltage ranges: .1 to 1000 (20,000 ohms per volt) . . . six a-c voltage ranges: 5 to 750 (1000 ohms per volt) . . . six d-c current ranges: 50 microamperes to 10 amperes . . . four a-c current ranges: .5 to 10 amperes . . . five resistance ranges: 3000 ohms to 30 megohms . . . all ranges full scale . . . a-c and d-c current ranges extended with external transformer or shunts. New temperature compensated rectifier circuit gives greater a-c accuracy.

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Get Network Advantages for Heavy Load Density Areas

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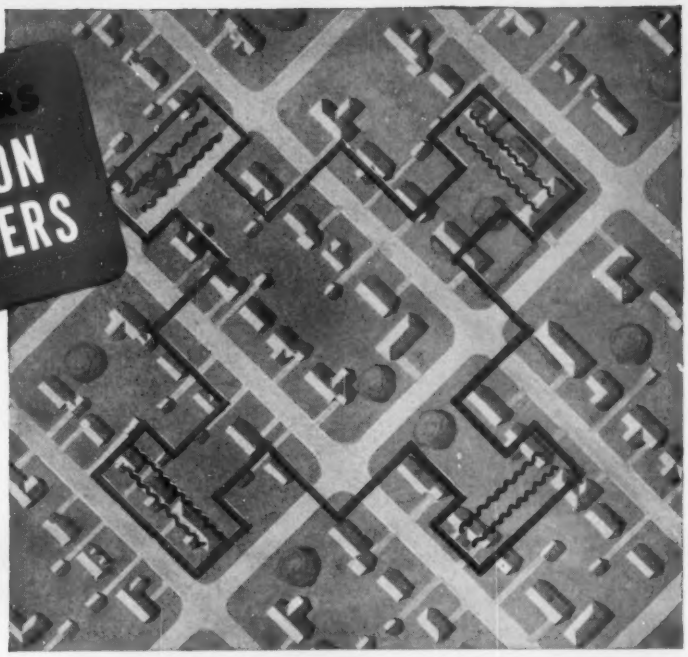
DISTRIBUTION TRANSFORMERS



Get the complete story on the advantage of Banked Secondary Systems from your nearby Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 61B8054.

ACPB TRANSFORMERS MAKE SECONDARY BANKING ECONOMICAL

You can distribute secondary loads and temporary overloads evenly and economically with ACPB distribution transformers. They permit bringing network advantages — improved service continuity, better voltage regulation, and less flicker from 120-volt starting loads — to heavy load density sections of urban and suburban areas. ACPB distribution transformers permit simplified paralleling of secondaries on systems fed by a common primary feeder.

Reduce total transformer capacity requirements. When ACPB transformers are distributing diversified loads efficiently, you can add capacity without increasing copper size. All you do is replace a transformer with one of a larger rating or add in another transformer of the same size to the circuit. Secondary fuses are completely eliminated.

ACPB transformers are supplied as a package that includes built-in lightning and system protection. To give short circuit and overload protection — plus a means of sectionalizing secondary faults — two internal low voltage breakers with separate external reset handles are provided. Two signal lights give visible warning of breaker operation. A-4218

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for Airport Lighting

CRESCENT IMPERVEX TRENCHWIRE and TRENCHCABLE are well known underground cables approved as TYPE "A" under CAA Specification L-824 for 600 volts.

Cables for 3,000 volt and 5,000 volt to the same specification can be furnished.

Tens of millions of feet have been giving outstanding trouble-free service for many years. Write for bulletins No. 491 and No. 492.

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TRENTON, N. J.

OVER 70 YEARS EXPERIENCE

Washington Report

A sound national economy is assured by most Administration spokesmen, and backed up by most private forecasters. The Government is prepared, however, to use "every legitimate means available . . . to sustain that prosperity", President Eisenhower declared in his January radio-TV report to the nation. Anti-recession moves most often mentioned: Easier money policies; tax cuts to spur business and consumer spending; public works financed in part by Washington, part by state or local governments.

The Federal budget for fiscal 1955 (July 1, 1954 to June 30, 1955) was presented to Congress by Eisenhower on January 21st. Spending was estimated at $65.5-billion for fiscal '55, down from fiscal '54 total of $70.9-billion. Income for fiscal '55 was estimated at $62.7-billion, down from fiscal '54 total of $67.6-billion (estimated). The resulting deficit of $2.9-billion will raise the existing national debt of about $274.5-billion to beyond the national debt limit of $275-billion. Eisenhower therefore requested an increase in the ceiling limit ($290-billion would satisfy most Administration officials) to meet this situation. Cuts in defense spending for national security accounted for most of the savings, will probably meet strong Congressional opposition.

Today's national debt totals $6,008 per family. Interest alone on this debt, up from about $55-billion at the end of 1941 to $274.5-billion currently, is roughly $144 per year per family, or ten cents out of each tax dollar. A government agency reports that, in addition, each family owes on the average of about $2,900 for department store bills, doctors' bills, the mortgage on the house or farm, and for other similar personal indebtedness.

Construction outlays last year climbed to record total of $34.8-billion for both public and private work, according to final report of Commerce Dept. This was 7% ahead of 1952's previous high record. Physical volume was also up by 5%.

Total electric generating capacity will pass the 100-million kw mark about mid-year. Capacity on January 1 was about 93.5-million kw, and additions this year are predicted at 12.5-million kw. Capacity in 1920 was under 13-million kw, doubled by 1927, doubled again by 1945, and this year is headed for twice the 1945 total.

Electric power output went above 9-billion kwhr per week in mid-January, to set a new high record. Total production for week ended January 16 was 9,013,905,000 kwhr. The year-ago total was 8.121-billion kwhr, and the 1946 average was 4.238-billion kwhr.

Domestic copper output has been reduced following decline in consumption in December to 83,652 tons, lowest level since July 1952 during the national steel strike. January shipments were down about one-third from the December low, with users reportedly relying on inventories. Kennecott trimmed production by 1400 tons monthly beginning February 1st, at two mines in Arizona and New Mexico.

Unemployment benefit claims are increasing at a new high rate. Commerce Dept. estimated jobless at over 2-million in mid-January, caused by layoffs in last half of last year by auto producers, steel companies, appliance and television makers and others. Jobless in February 1950 was 4.7-million, decreased gradually to low of 1.1-million in early 1953.

Strike losses in 1953 totaled 27-million man-days of work, brought about by more strikes but of shorter duration. Idleness in 1952 totaled 59,100,000 man-days, and in 1951 a post-war low of 22,900,000 man-days.

THIS SWITCH "TALKS" TO YOU WAY ACROSS THE ROOM

THERE ARE NO ifs, ands, or buts about the handle of the Noark Front-Operated Industrial Switch. This is a streamlined "he-man" handle...easy to see from a distance and from all angles...tells you at a glance whether it's at the "On", or "Off", position. And, of course, front operation let's you gang these switches ...install the largest number in the smallest space.

Federal Noark Front-Operated Industrial Switches are built for the cool operation that assures longest and trouble-free service life. Besides that, they're the *safest* safety switches ever put on the market. They have guaranteed current break...visible blade construction...a tamper-proof locking system... patented Rolarc® arc-quenchers that extinguish arcs instantly.

Order Federal Noark Front-Operated Industrial Switches from your distributor for *everything* in practical, modern switch design and top dollar value.

Federal Electric Products Company, 50 Paris Street, Newark 5, New Jersey

Federal Noark products: Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct — **Pacific Electric Manufacturing Company products:** High voltage circuit breakers and power switches ★ Sales offices in principal cities.

FEDERAL NOARK®

Comments on "The Wrong Road"

Our editorial "The Wrong Road" last month was a critical look at some of the aspects of the current NECA Business Development Program. It has aroused much discussion since it appeared.

Because of the explosive potentials in the issue, we are giving the following industry comments without names (with one exception).

"We would like permission to make reprints of your editorial in the January, 1954, issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE for the purpose of distribution to the members of the National Electrical Contractors Association."

George B. Roscoe
Director of Public Relations
National Electrical Contractors Assn.

Granted. We asked for the widest discussion.

"Does Macy advertise to buy your merchandise at Gimbels?

"Do Lucky Strikes tell you that Camels has finer tobacco?

"There is nothing wrong with our Business Development Program that is designed to help those who contribute their time and money to advising the public that there is an Electrical Contractor ready and willing to serve them.

"We have told no one not to patronize the other 13,000 who are too lazy or too penurious to do anything to help themselves or their industry.

"NECA membership is open to any qualified contractor who wants to join in our activities, and we have openly invited them to join with us.

"Knowing you as I do, and knowing how devoted you are to promoting the Electrical Industry as a whole, I was surprised at your Editorial in the January issue of "Electrical Construction and Maintenance."

Signed NECA member

But Macy is *not* a *trade association.*

"Your article "The Wrong Road" in Electrical Construction and Maintenance" was very interesting to me.

"I would like to have 25 copies of that article if possible.

"I am a NECA member and our Chapter did not approve of the NECA Business Development Program and still does not approve of it.

"You brought out one item that interests me very much and which is why I am more than anxious to receive the extra copies."

Signed NECA member

Copies sent.

"You are certainly to be commended for your editorial in the January issue. I heartily endorse everything you have said and only wish that there was something we could do to make your editorial more impressive.

"As it is, we have refused to go along with NECA in the program it has developed."

Signed manufacturer

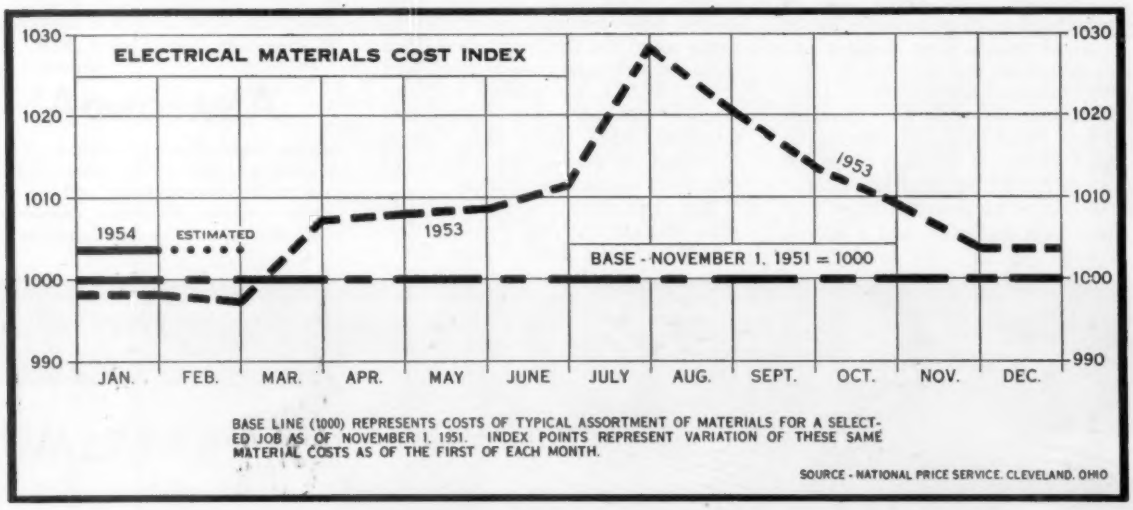
The substance of the comments received disapproving of our editorial are:

a. That a national advertising program to sell specifically the services of *member* contractors is an appropriate activity for the Association.

b. That non-members do not contribute and consequently are not entitled to the rewards of the program.

c. That membership is open to all qualified contractors and if a non-member wants to be outside that is his own choice.

We can urge these good folks to read the editorial again and to study their program not as a member, but as a non-member, and ask themselves again if it is good for them and their industry. We hope they will seek out not only whom it helps but whom it hurts, and then decide whether they actually want to move in with their fellow members jointly and openly on their customers and prospects through national and local advertising.



1. SILVALINE makes a neat weatherproof outdoor installation and **2.** is economical to run through meter and fuse boxes to range.

You save time when you go right to the range with SILVALINE

You can run SILVALINE* Service Entrance Cable from pole or weatherhead to range or water heater . . . avoid trouble from damp cellars or crawl-spaces. You save, too. SILVALINE—furnished with copper or aluminum conductors—costs less to install *and* buy. Conduits are not needed.

SILVALINE is the only Type SE cable with URC saturant and finish—an exclusive ANACONDA feature that assures long protection and a smooth surface. Over this, a silvery paint is applied which, when the cable is installed, will take any type or color of house paint. The URC saturant will not come through even a single paint coat!

SILVALINE has greater heat and weather endurance, too. Color-coded neoprene tapes make identification easy, and the glass-cotton outer braid effectively resists deterioration.

Ask your electrical wholesaler to show you SILVALINE Type SE Service Entrance Cable. If he doesn't have it, write for information directly to *Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.*

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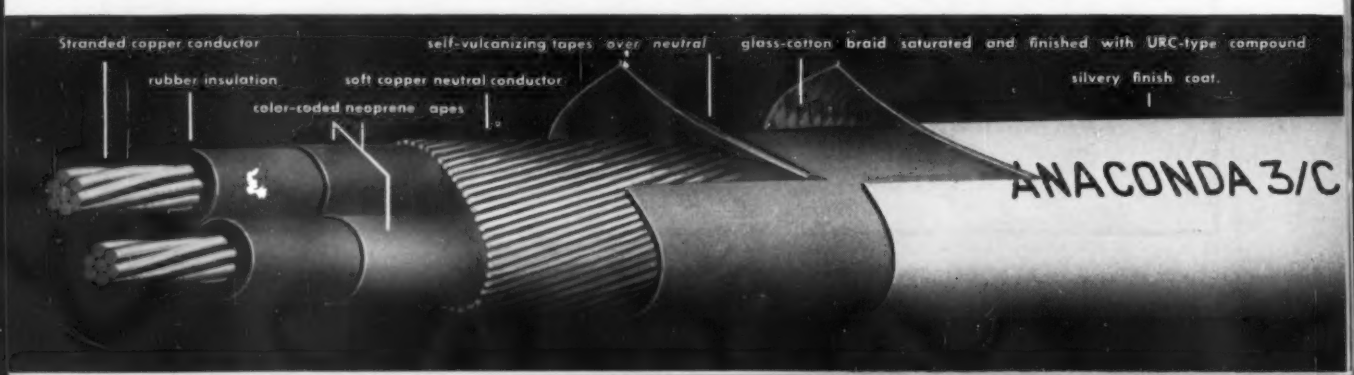


ELECTRICAL CONSTRUCTION AND MAINTENANCE

53rd Year—FEBRUARY • 1954

Out With Over-Thirty Wire

THIRTY YEARS AGO we were well along on one of the greatest construction eras in history. Office buildings of that time are prominent in most of our business districts today. They are still new. Thirty years show little effect on a well designed structure of steel, brick, concrete, and glass.

THAT SAME ERA brought "modern" wiring and lighting. After the first world war the electrical construction industry grew tremendously. Electricity was here to stay. We had enclosing glassware and indirect luminaires. The lone central lighting fixture in the office was giving way to orderly patterns of several units per bay. Open knife switches were going out, replaced by better and safer dead-front panels.

TO MANY OLD TIMERS these are nostalgic memories. But to present day electrical contractors and building managements they present the elements of a grave and growing crisis. Thirty years are only a moment to inert structural materials but they are a long lifetime to organic electrical insulating compounds.

THE FORCES of advancing utilization requirements and the effects of oxygen, heat, moisture and vibration on insulation are converging. They threaten imminent electrical paralysis to the ever increasing numbers of buildings reaching the critical thirty year age. Both forces are cummulative and each aggravates the other. The older the wiring system the less likely it is that it can support additional loads. As loads are increased the additional heat in the conductors accelerates the aging of the insulation.

ALMOST ALL OFFICE BUILDINGS over 10 years old need substantial rewiring to serve present and potential loads. One hundred foot-candle general lighting, air conditioning, office machines, electric water coolers and other services and devices are normal facilities of contemporary business establishments. Much of the additional load can be served by enhancing the capacity of existing systems with additional wiring.

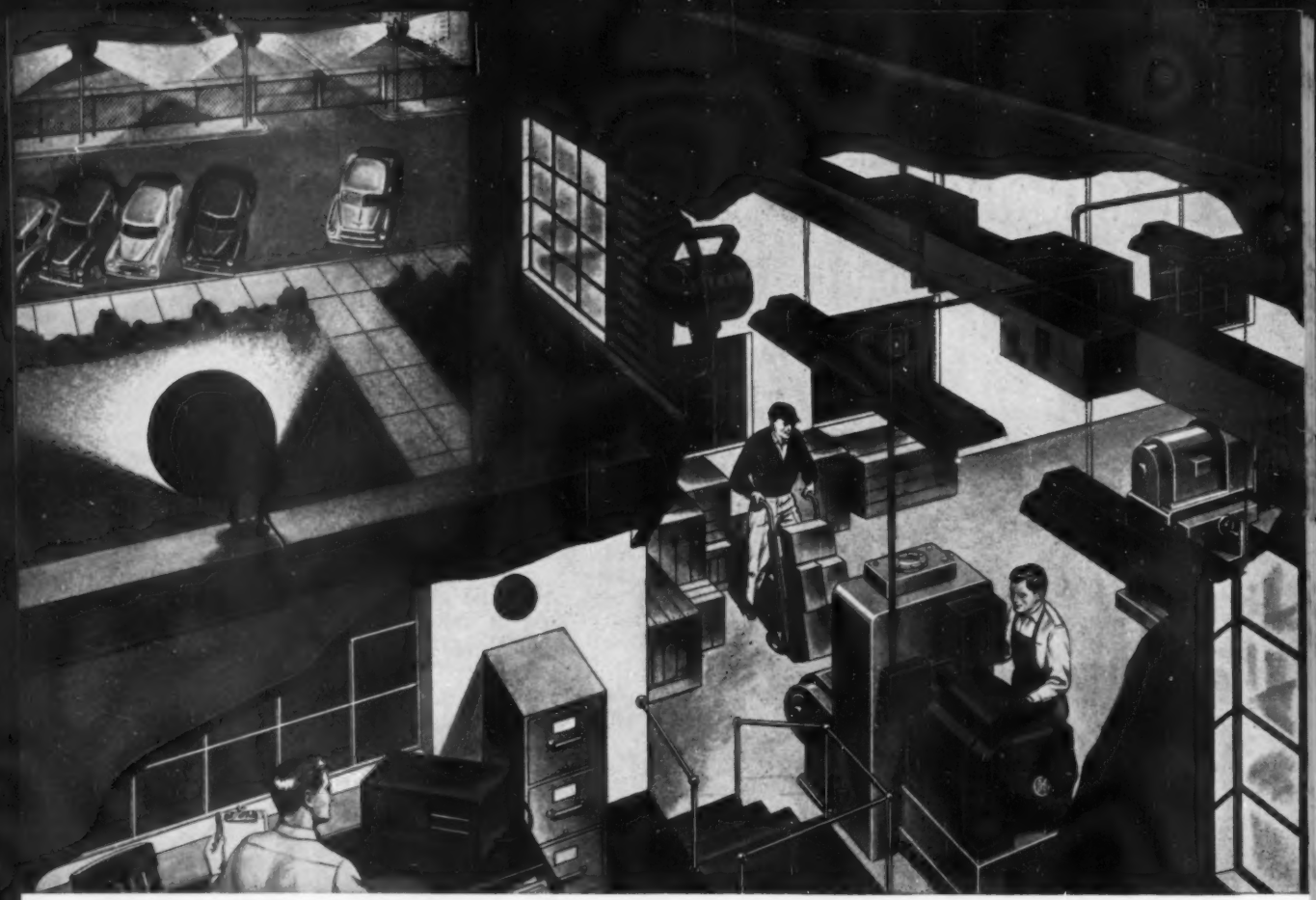
BUT THE OVER-THIRTY BUILDING presents a more exacting job. The existing wire, hidden away in conduits, may test satisfactorily on a meter. The exposed ends in the larger and cooler space of the panelboard gutter or junction box may look sound. But inside the conduits the insulation may be ready to crumble to powder at a touch.

THE PROBLEM PLACES a heavy load of responsibility on the electrical contractor. A lot of building rewiring is handled by competitive bidding. The low price may be contingent upon the maximum use of existing feeders and branch circuits. Rewiring at best is expensive, often bought reluctantly by building managers under pressure of dire necessity. And nobody but the contractor has the special knowledge and experience to know the concealed hazards that may be present.

TO MEET THE CHALLENGE will take a lot of courage. But the plain fact is that "over-thirty" wiring can be hazardous as a result of aging alone and even more so if it has been subjected to full and continuous loads. A sampling of insulation condition should be insisted upon before contracts are signed and owners urged to replace all existing wire whenever the samples disclose substantial decay.

Wm. T. Stuart

For comments on our January editorial, "The Wrong Road", see page 61.

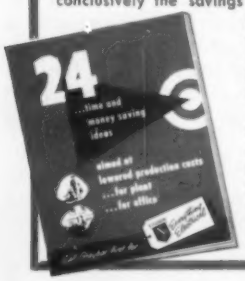


MORE THAN 100,000 ELECTRICAL ITEMS are promptly available from nearby Graybar — complete wiring systems for any industrial need . . . apparatus for power distribution . . . indoor and outdoor lighting units and lamps . . . ventilating, signaling, and "intercom" equipment . . . plus cable, conduit, wiring devices, and tools needed to install them.

If it's electrical, you can get it from Graybar

SEND FOR YOUR FREE COPY, TODAY

This fact-filled booklet "24 Time- and Money-saving Ideas" gives actual case-history proof of the statements made at right . . . demonstrates conclusively the savings possible through improved utilization of electrical equipment of all kinds. Write to the address below for your copy.



For more information relative to any electrical installation, however, call your nearby Graybar Representative — he'll be happy to serve you.

And, because you want efficient service, here are four more reasons why your next order for electrical equipment and supplies should read "via Graybar."

1. Graybar distributes the products of over 600 of the nation's leading manufacturers — well known lines of proved design and construction.

2. You can get complete price and specification data on all these items through your local Graybar office or warehouse.

3. Local stocks of standard electrical items and fast delivery on non-stock lines assure on-schedule deliveries for both construction and every-day maintenance jobs . . . in emergencies, shut-down time can be held to a minimum.

4. Graybar Specialists in all of the major electrical fields are always available for consultation on out-of-the-ordinary projects. You can rely on them for careful analysis of your customer's requirements and complete impartiality in product recommendations.

Make it a point always to call Graybar *first* — a single source . . . a single responsibility will save you time and money.

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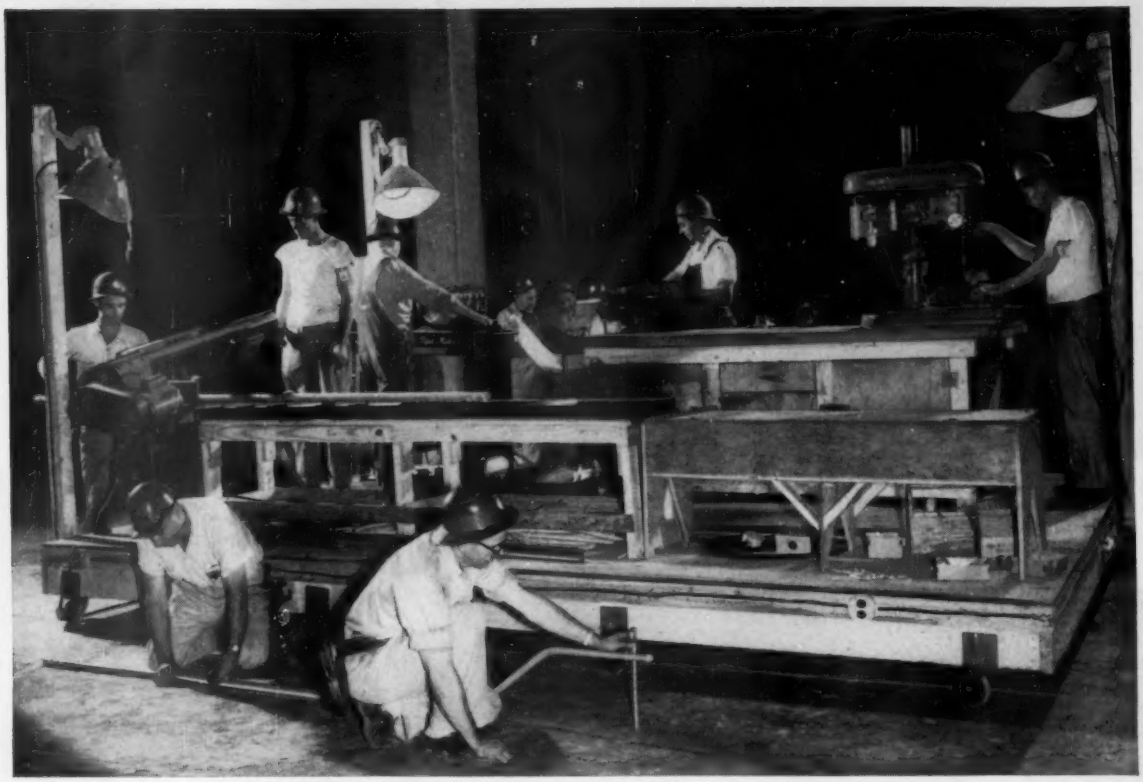


POWER TOOLS and integral floodlighting system on wheels follow installation progress.

Contractor's Shop on Wheels Apply

New Mobile Mechanized Techniques

To A.E.C. Construction

At the new Paducah Area A.E.C. project in Kentucky, Schulman Electric Company put all but pocket tools on wheels to cut installation time and maintain tight construction schedules.

By August Eckel

THE RACE against time and mounting construction costs in the building of national defense facilities has led to the development of some of the most unique installation methods in the history of the construction industry. Probably the largest combination of such ideas can be found on the gigantic United States Atomic Energy Commission projects throughout the country. Here, thousands of skilled craftsmen have the opportunity of suggesting and applying new techniques in their respective fields. What happens when this is done can be mighty enlightening to a construction field engineer. Such is the case at the A.E.C. gaseous diffusion plant being constructed near Paducah, Kentucky, by F. H. McGraw & Company, prime A.E.C. contractor at the project.

Unique ideas are not confined to the operations and problems of any

CONDUIT CARRIAGE fashioned from Unistrut sections advances conduit through pivoted hydraulic bender for multiple-step offset operations. Note use of protractor-level (left) to measure angle of bend. Hydraulic knock-out punch is also being used on rolling platform.

UNDER-SLUNG MOBILE RIG is used to move heavy switchgear and transformers. Unit has four hydraulic jacks, heavy pipe cross-pieces and eight wheels (individually controlled) to maneuver equipment onto mounting bolts. Gantry units (straddling cubicles) are also used.

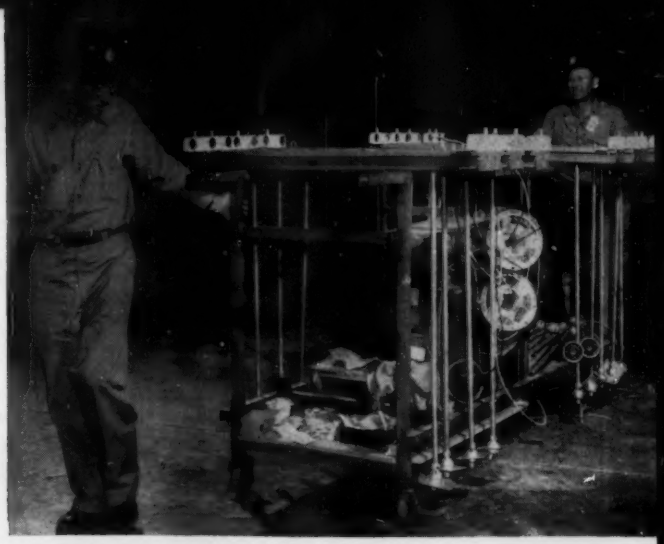
one or two trades. All have a hand in pushing project construction to an early completion date. The exceptionally tight construction schedule makes this almost mandatory.

Outstanding example of what can be accomplished by constructive, collective thinking is the group of mobile mechanized techniques devised by the A. S. Schulman Electric Company (of Chicago), chief electrical contractor working under F. H. McGraw & Company. First inkling of things to come was the arrival of hundreds of wheels and casters at the electrical materials depot at the project. Puzzled expressions of stock men and some field engineers soon changed to smiles of understanding as they witnessed the evolution of the mobile system. For it wasn't long before electricians in the process buildings were busy fabricating material on rolling workshops complete with benches, drill presses, power pipe threading machines, metal cutting band saws and integral floodlights. These platforms on wheels are 12-feet long and 6-feet wide so they can be easily moved through narrow spaces; are designed so that two units can be bolted together to make a 12-ft. by 12-ft. work space.

Supplementing the workshops are a series of rolling conduit-bending tables, each with one or more hydraulic benders to handle conduit from ½ in. to 4 in. diameter. Platform height is approximately 24 inches so mechanics can work either from the platform or standing position on the floor. Some of the tables have vari-colored radius lines for all radius bends from 9 inches up to 48 inches. Others are equipped with automatic angle-indicators which, when attached to the conduit by clamp or magnet, automatically give a direct reading of angle of bend at any time during the multi-step operation.

All tables are equipped with a conduit carriage device to reduce bending to a two-man operation. The assembly consists of two steel plate uprights between which one end of the hydraulic bender frame pivots on a bolt shaft. Two lengths of continuous channel (Unistrut), bolted to the platform,

PORTABLE WINCH with attached boom is rolled up to cubicle interior to pull in overhead feeder cables. Mechanic on left contacts re-reeling crew through intercom.



ROLLING FIXTURE RACK holds about a dozen assembled fluorescent units. Base platform stores fixture bodies, parts, stems, wire, torch, solder and other assembly accessories.

THREE-SIDED TEST ROOM is rolled up to panel or cubicles to isolate test operations from dust and noise. Interior view shows full complement of instruments and test circuits.

form rails for a dolly which supports the free end of the conduit section in a standard split clamp. A hand-crank windlass with steel cable pulls the dolly toward the bender as the premarked conduit is advanced slightly for each step of the bending operation. The mechanic operating the hydraulic motor watches the automatic angle indicator while a second man moves the conduit carriage. The net result is a smooth, accurate bend made in an exceptionally short time—a necessity on a project of this type where thousands of offsets are made with many of them duplicates for parallel conduit runs.

Mobile Scaffolds Abound

A variety of rolling scaffolds and rigging is used throughout the process building areas. Many are of the standard sectionalized type; others are site fabricated to solve specific installation problems. Two adjustable square towers are an example. These four-foot square units are made of continuous channel (Unistrut), are nominally eight feet high and can be adjusted up to 14 feet. A platform with guard rail spans the two towers providing electricians with a 20-foot long elevated walkway that can easily be pushed along the floor to follow installation progress.

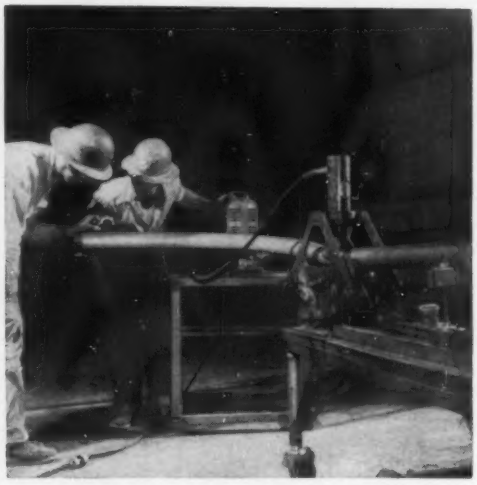
To reach high-bay areas, Schulman mechanics designed and built two movable rigs. One is a side-slung suspended scaffold that rides along a crane rail and beam some 45 feet above floor level. Used primarily for installation of the crane trolley duct, the all-steel platform has a waist-high guard rail and accommodates three electricians who can work comfortably at chest height. Lighting above the craneway is being installed from a platform workshop bridging the 53-foot span. The steel truss-like structure rides the two crane rails, can be easily dismantled for use in other areas, carries a complete complement of tools and equipment, permits high-bay installation work to proceed before bridge cranes are installed.

Material Handling

A substantial portion of the man-hour economy is realized by putting

SIDE-SLUNG SCAFFOLD speeds crane trolley duct installation. Unit rides on crane rail and beam; suspends three electricians in comfortable working position; has attached tool and parts chest.

MOBILE CONDUIT-BENDING TABLE is equipped with power-driven and hand operated hydraulic



LARGE HYDRAULIC BENDER is operated by hydraulic motor on portable table. Raising material to comfortable working level increased efficiency.

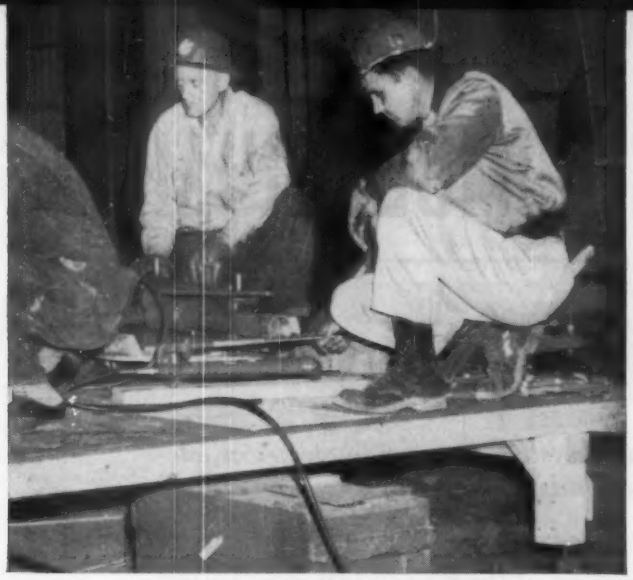
wheels on practically all of the material handling equipment. Mobile pipe racks and rolling box bins assure an adequate supply of conduit, fittings and wiring accessories at all times; follow job progress throughout the tremendous buildings. The pipe racks are triangular A-frames on a rectangular base. Angle-iron brackets form three racks on each side to support six different sizes of conduit. Two men can easily push a loaded rack along the concrete floor. Similar units with horizontal cross-arms of continuous channel (with adjustable stop bolts) are used to transport multiple lengths of offset conduit from the bending tables to actual points of installation. A rectangular rack (made of continuous channel sections) holds about a dozen assembled fluorescent fixtures including suspension stems; is equipped with a base platform for tools and parts required in assembly; rolls easily on four casters.

Mobile rigs of gantry and under-slung design are used extensively to lift and move transformers and switchgear. The gantry units are steel frames on wheels with sufficient height to straddle cubicles or large motors. By means of hoists, the equipment is raised off low-boy trucks, rolled into place and set on installation bolts. No rollers are necessary. The under-slung units are equipped with heavy hydraulic jacks.

Rolling parts bins, one for each electrical gang, are made of plywood on a rectangular angle-iron frame; feature dual side-access to enclosed cabinets at the base and open bins above. Larger wiring accessories and installation equipment items are stored in rolling cages. Even the small-work area field offices are on wheels.

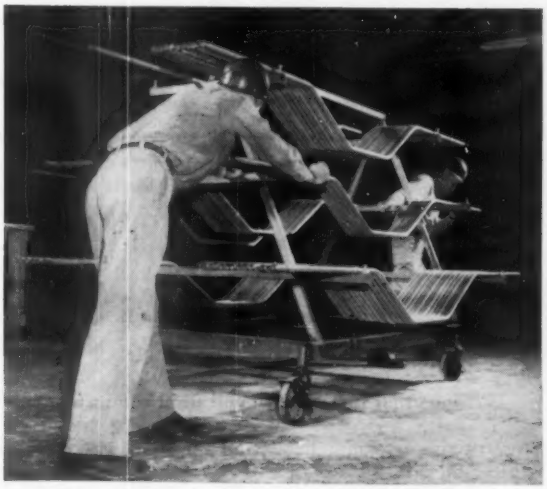
Cable Handling

To swing heavy power cable, reels of which weigh from two to four tons each, Schulman mechanics designed and built a special reel cart. Hydraulic jacks, mounted in the channel-iron cart frame, provide adjustable support for the reel axle. Winches on wheels, complete with integral boom attachment, are rolled up to cubicle interiors;

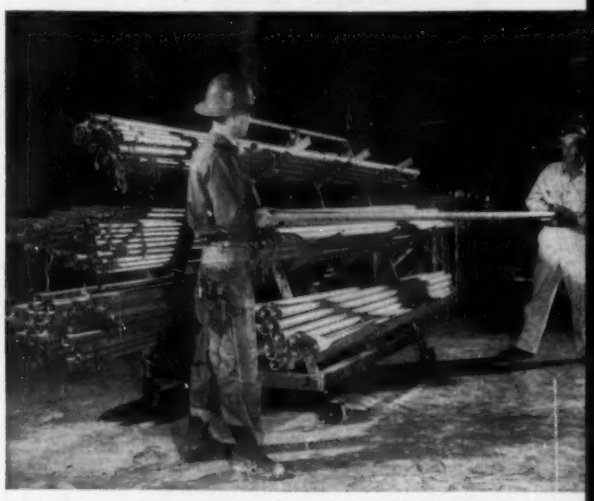


benders; permits mechanics to work from platform or floor.

MOBILE CABINET CRIB combines enclosed cabinet base, work shelf and small parts bins with access from both sides. One of these units follows each electrical crew.



PRE-BENT LENGTHS of conduit are moved en masse on mobile rack from conduit bending platform to points of installation in large process building.



ROLLING STORAGE RACK permits two mechanics to distribute more than 1,000 feet of conduit throughout building area. Side brackets hold six sizes of conduit.

pull feeders through the overhead conduit raceways. For other cable installation operations, conventional power operated winches mounted on dollies and rolling tables are strapped to building columns for the pull.

A switch in conventional cable handling methods is used to advantage in underground tunnels where power cables are laid in Transite wall troughs. Normal procedure is to establish a stationary reel setup, then pull the cable in the troughs over rollers or conveyors. Schulman's men reverse the technique. They anchor the cable at one end of the trough, put the reel on a dolly and move it along the tier of troughs. As the reel-dolly is pulled along, the cable unreels and is automatically laid in the trough through a swivel conduit "gooseneck" (on the dolly assembly) which is adjustable to the different trough heights.

Fairly effective isolation of test personnel from the distractions and noise of surrounding construction activity is provided by the use of a rolling test cubicle made of plywood. The three-sided "room," 10-ft by 8-ft. by 8-ft., is used, where practicable, for testing switchgear and controls, calibrating and adjusting meters and electric relays. The unit is rolled up to a panel section. Its open side is locked in an airtight connection with the panel to provide dust-tight and noise-proof seclusion for test personnel. The interior is completely equipped with all necessary test circuits, instruments, tools, power service, receptacles, compressed air and handy workbench area.

These are but a few of the innovations introduced at the Paducah project to extend the productive capacity of some 1,400 electricians. As one observer so aptly phrased it: "They've put everything but pocket tools on wheels". Here is another chapter in the history of electrical construction industry progress—a history replete with contractor ingenuity and installation know-how. The Paducah story can be added to the growing list of projects where astute field engineering combines with original design engineering to produce a better electrical job more economically.

New Planning Ideas for . . . MODERNIZING

Step 1: *Thoroughly inspect and analyze the existing electrical system to determine extent and nature of inadequacy.*

Step 2: *Make preliminary design of a system to provide electrical adequacy and reserve capacity, within the limits imposed by the economy of the particular situation.*

Step 3: *Make final layout and installation of the new system, dovetailing the new system with existing equipment, as economy and structural characteristics demand.*

The urgent need for rewiring existing buildings is attracting wide public attention. The forces of obsolescence and load growth are inexorably pressing building management to enhance and replace existing wiring systems designed long before present commercial electrical requirements were even contemplated.

To support and rebuild an existing wiring system has all of the problems of new construction. But it also has other problems as varied as the types of construction and occupancy.

The need for practical data to guide those who must plan and install electrical systems in existing building is also apparent. Other than actual job reports which are published from time to time in *Electrical Construction and Maintenance* there is relatively little in print on the subject.

There is urgent need for even elementary standards of system design. Electrical modernization work offers an important challenge to the technical societies and to the research facilities of our industry.

To fill the gaps we have applied our own editorial staff resources to the problem. This is the first of a series of articles in which we shall take up the electrical modernization of various types of commercial structures.

From the beginning we found that much of the needed data had to be built and developed out of field investigations. Consequently this article and those to follow are presenting important, and possibly unique, original data including the load requirements per square foot of several kinds of facilities.

We hope that this material will stimulate further study along these lines by appropriate industry committees toward a more comprehensive treatment of the problem. In the meantime we have endeavored to make it practical enough for immediate use by those who have actual jobs under consideration today.

STEP 1 — Inspect Existing System

THE first step on any office rewiring job is a complete inspection and analysis of the electrical system as it exists prior to modernization. From the last plug receptacle right down to the service entrance, the existing system should be carefully checked over.

Only from thorough inspection of the existing system can the extent and nature of wiring inadequacy be determined. And only from an intelligent appreciation of the inadequacy of the existing system can modernization be scaled to the requirements of a particular interior. A series of voltage and ampere readings on feeders and circuits at panels will readily point up deficiencies in wiring capacity. To clarify the situation, readings should be noted on a set of plans (if any are available) of the existing system or on a free-hand sketch of the system, made during the survey.

Although preliminary analysis is made before any actual plans are conceived for revamping the existing setup, each segment of the existing wiring system should be checked with attention to alternative possibilities for expansion. Condition of wire insulation, feeders and associated wiring devices, panels and enclosures often indicates extent of required work. Physical and structural layouts of interiors are further determining factors. Other factors which should be noted during inspection and related to possible modernization schemes are:

OFFICE BUILDINGS

SURVEY OF DISTRIBUTION—120/208-v 3ø—4w

Feeders and Riser Conduits	Feeder Disconnect -Protection SW—Fuse	Amps-Feeder Current Capacity	Feeds Panels	Amp-Reading at Panel Mains	Number Circuits in Panels	Number Spare Circuits	Overload(−) Spare Capacity (+) Amps	Type Panel	Condition of Feeder Insulation
4"8R 1"C	60A@40A	40A	1-A	35	10	2	+5	LIVE FRONT	GOOD
4"4R 1½"C	100A@100A	70	2-A	36	10	0	-24	do	DRIED OUT AND BRITTLE
			2-B	58	10	0		do	
4"1R 2"C	200A@125A	100	3-A	38	10	1	-16	do	DRIED OUT AND BRITTLE
			3-B	44	10	0		do	
			3-C	34	10	1		do	

BRANCH CIRCUIT SURVEY—AT PANEL 4th FLOOR

Circ. #	Fuse Size-Amps	Load Amps	Wire Type & Size	Conduit	Type Circ.
1	20	13	14R	½" H.W.	LTG.
2	15	10	14R		do.
3	15	9	14R		do.
4	15	11	14R	½" H.W.	RECEP. & FANS
5	25	18	12R	½" GRNFLD	UNIT HEATERS

TABULATED DATA, developed from electrical survey, can be laid out in these forms for clear, easy reference when approaching design of modernization work.

Access to existing conduit
Location of hidden conduit
Space for running new conduit
Spare conduit risers
Availability of riser shafts
Space for additional panelboards
Locations for new outlets
Possible application of surface raceway
Existence or possible application of hung ceilings

On the basis of thorough analysis, the range of possible modernization should be discussed with the owner. Consultation with tenants, building engineers and operating personnel can also prove helpful in approaching redesign of the electrical system. Of course, anticipated future loads should be discussed and brought into the modernization picture.

All of this checking and inspecting will give a good idea of the design approach to be adopted. The next step then is preliminary design of the modernization.

CHECK LIST FOR EXISTING-SYSTEM SURVEY

- Number, location and loading of all utilization outlets—both permanently connected and plug outlets.
- Size, type and loading of branch circuits.
- Number and wattage of lighting fixtures.
- Air conditioning loads and layout of supply circuits.
- Number, size and loading of other power circuits.
- Layout of signalling and communication equipment.
- Number, location, type and loading of light and power panels.
- Sizes and types of branch circuit protective devices.
- Number and sizes of risers.
- Number, sizes and loading of all feeders.
- Number, location, type and loading of feeder distribution panelboards or feeder disconnect and protective devices in switchboard.
- Type of distribution system used.
- Number, sizes and types of service conductor disconnect and protective devices.
- Number, type and sizes of services.

MODERNIZED PANEL SCHEDULE—ALL SWITCHES 230 VAC, 250 VDC 3PST, FUSIBLE

Panel	Capacity Mains Lugs Only	Feeder Switches	Panel Type	Cabinet	Switch Allocations	Capacity of Solid Neutral Bus
V-1	200 A. TOP & BOTT. CONN. FOR THRU FEED	TWO - 60 A.	LIVE-FRONT	NEW-SURFACE	ONE EACH FOR VENT. UNITS NOS. 4 & 5	60 A
V-2	200 A. BOTT. CONN.	THREE - 60 A.	do	do do	ONE EACH FOR PANELS V-3, V-4 & VENT. UNIT NO. 13	60 A
V-3	60 A TOP CONN.	ONE - 60 A. TWO - 30 A.	do	do do	VENT. UNIT NO. 6 ONE EACH FOR VENT. UNITS NOS. 9 & 17	30 A
V-4	60 A. BOTT. CONN.	ONE - 60 A. TWO - 30 A.	do	do do	VENT UNIT NO. 16 ONE EACH FOR VENT. UNITS NOS. 8 & 12	30 A
V-8	60 A. TOP CONN.	THREE - 30 A	do	do do	ONE EACH FOR VENT. UNITS NOS. 3 & 11 AND FEEDER TO VENT. UNITS NOS. 15 & 19	30 A
3-SW	200 A. BOTT. CONN.	THREE - 100 A	do	EXISTING-FLUSH	ONE EACH FOR FEEDERS TO PANELS 3-5, 6-5 & RM. 615	200 A
3-NW	200 A. BOTT. CONN.	THREE - 100 A	do	do do	ONE EACH FOR FEEDERS TO PANELS 9-5, 11-5 & RM. 609	200 A
ELEVATRS NO. 5 & 6	200 A. BOTT. CONN.	TWO - 100 A ONE - 30 A	do	NEW-SURFACE	MG SETS FOR ELEVATORS NOS. 5 & 6 CAR LIGHTS, SIGNALS, ELEV. MACHINE RM. LTG.	30 A
ESCALATRS	100 A. TOP CONN.	TWO - 60 A ONE - 30 A	do	do do	ESCALATOR MOTORS LTG. IN ESCALATOR MACHINE RM. & AT ACCESS DOORS	30 A

PANEL SCHEDULE tabulates power and feeder data from preliminary design for one part of a large office building in which new lighting and ventilating blowers were installed in a modernized electrical system supplied from both ac and dc services.

STEP 2 — Preliminary Design

After a comprehensive inventory of existing circuiting and distribution and a study of available wiring capacity in relation to requirements of existing loads, a preliminary plan for modernization can be drawn up. Of course, preliminary planning should be aimed at finally deriving a plan for the type of modernization the owner requires, as determined from consultation with the owner during the electrical survey. In general, electrical modernization falls into three types:

CASE I. Relieving existing conditions of electrical overload—the minimum job, usually encountered in an individual office area, a small office building on one or two floors of a multi-story office building.

CASE II. Providing wiring capacity for new lighting and/or air conditioning—a bigger job than the first case, but again usually confined to only a small office building or part of a large office building.

CASE. III. Providing wiring capacity for new lighting and/or air conditioning, with full consideration of future anticipated loads.

Actually, relief of existing overload may also be part of Cases II and III. And provision of wiring capacity for new business machines and other special loads may be part of all three cases. Of course, other overlap between these cases is possible on a particular job. But, some such pinpointing of the scope of the job is necessary in evolving a final plan. A closer look at each of the above described cases will clarify the preliminary approach.

CASE I. Relief of existing overload boils down to installation of adequate circuitry for existing loads. Conditions of overload are typical. A steady accumulation of incidental lighting units, electric business machines or a few unit type air conditioners has resulted in "octopus" outlets. All circuits are either loaded to maximum or overloaded. Feeders also are probably overloaded. Electrical survey readily reveals the extent of wiring inadequacy.

Determination of circuit requirements for this case is approached as follows:

1. Determine conditions of proper loading on existing circuits. How much of existing utilization devices represents the proper handling capacity of existing wiring?

2. Determine load for which additional branch circuit capacity is required. How much of existing load should be handled by new circuits?

3. Determine number and type of new circuits required to provide necessary outlets for load obtained from "2".

4. Determine required feeder capacity for the new total branch circuit load and determine number of circuit overcurrent devices required in panelboard(s) serving the area.

Preliminary planning for this case should take into consideration such factors as:

Load centers of existing utilization devices.

Locations for additional outlets.

Type and amount of switching required (branch circuit control).

Possible effect on design of a change in electric service.

Overall advisability of more extensive rewiring than was originally designed.

Rewiring only to relieve existing overload should be recognized as a stop-gap measure. The advantages of installing a system better than minimum should be clearly explained to the owner. The better job should always be sold up.

CASE II. Providing wiring capacity for new lighting and/or air conditioning differs from Case I in the size of increased load to be handled. New feeders and panelboards are invariably necessary and a complete new layout and routing of branch circuits must be made.

Preliminary planning for this type of modernization generally involves an overall new design of system elements right back to the service entrance. In order of approach, planning for this

case should include:

Design and layout of the new lighting system for required foot candle level.

Spotting locations of air conditioning units and other special electrical devices.

Computing lighting and air conditioning loads.

Splitting up the loads and calculating and laying out branch circuits and outlets for these loads.

Laying out plug receptacles for business machines, portable appliances and other devices.

Calculating size, number and possible locations of panelboards, with overcurrent devices.

Determining number and capacity of feeders and conduit risers required.

Determining required type, size and number of feeder protective devices and disconnects.

Determining required size of service and SE switch.

CASE III. This type of project involves the installation of new lighting and/or air conditioning and provision in the wiring system for a definite amount of load growth.

For the most part, procedure in this case of modernization work is essentially the same as Case II except that it involves all or almost all of the area in a particular building. In most instances, a little selling effort based on the advantages of adequate wiring can convert a Case II job to Case III.

Here preliminary design covers the same factors as in Case II. Overall design of a new system is made on the basis of existing loads, the new loads and an approximated amount of load increase in the future. In estimating provision of wiring capacity for growth, several factors present a sound guide:

What has been the load growth over the past 5 to 10 years?

How much more equipment could possibly be used in the various areas?

Is there any likelihood that the need for higher footcandle intensities of lighting will arise in the future?

What do the owner, tenants and building personnel have to say about possible future needs?

In most cases, allowance for load growth depends on the particular conditions of the office area being modernized. A high rent area, for instance, has a higher probability of appreciable load growth than a low rent area. Large buildings usually require greater allowance for load growth than small ones. Space capacity can be allowed by oversizing branch raceways and home runs, allowing spare circuits in the panelboard, oversizing new risers and feeders, including future load in the size of service and SE equipment.

STEP 3 — Final Layout

Varying with the preliminary plan for modernization and particular local codes, final layout of a job consists of dovetailing the new design with the old setup. Typical cases of modernization practice can be considered for the various segments of the overall system.

BRANCH CIRCUITS: Many possibilities exist for revamping circuit wiring. The application of these different methods will depend, of course, on the scope of the project as determined by preliminary design.

For the minimum job of overload relief, when economy demands the use of as much existing equipment as possible, rewiring of existing conduit to higher percent fill, Secs. 3466b, 3486 and Tables 11, 12 and 13 of NEC, offers many combinations for expansion. The code provisions cover rewiring of existing "raceways"—including rigid metal conduit, flexible metal conduit, EMT, underfloor raceways, cellular metal floor raceways, wireways, busways and auxiliary gutters. Application of this provision may be made in a number of ways, depending upon specific requirements:

1. Install a new panelboard in old cabinet, rewire existing home run(s) and circuits to 50% fill.

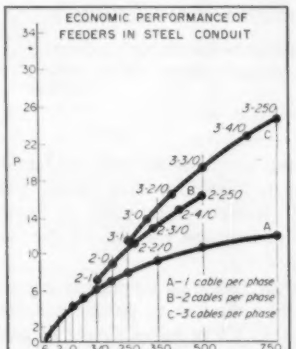
2. Use existing panelboard, rewire home run(s) to 50% fill, run flex and EMT for new circuits.

POWER FEEDER SPECIFICATION DATA

P	Cable Size	Cables Per Phase	Conduit Size	Cost in Dollars Per 100 Feet	Ampere Rating NE Code	Dollars Per 100 Feet Per Unit P	Economic Choice
2.0	4	1	1¼	$136.00	70	$68.00	
3.0	2	1	1¼	151.00	95	50.30	
3.7	1	1	1½	189.00	110	51.10	
4.6	0	1	2	237.00	125	51.50	
5.5	2/0	1	2	260.00	145	47.20	
6.6	3/0	1	2	286.00	165	43.40	
7.4	1	2	2½	342.00	176	46.30	B
7.7	4/0	1	2½	356.00	195	46.30	A
8.2	250	1	2½	421.00	255	51.40	B
9.2	0	2	2½	378.00	200	41.10	A
9.5	350	1	3	532.00	310	56.00	C
11.0	2/0	2	3	468.00	232	42.50	A
11.0	500	1	3	622.00	380	56.60	C
11.2	1	3	3	472.00	231	42.20	B
13.2	3/0	2	3	521.00	264	39.50	A
13.8	0	3	3	526.00	262	38.10	A
15.4	4/0	2	3	586.00	312	38.00	A
16.4	250	2	3½	755.00	408	46.00	B
16.5	2/0	3	3½	634.00	304	38.40	A
19.8	3/0	3	3½	713.00	346	36.00	A
23.1	4/0	3	4	848.00	410	36.70	A
24.5	250	3	4½	1085.00	535	44.30	A

Wiring in steel conduit for up to 600-volt three-phase 30 C ambient NE Code ratings.
Size 250 MCM and above—Heat and moisture resistant rubber type cable insulation with 75 C rating.
Below 250 MCM—Thermoplastic cable insulation with 60 C rating.

*A—Preferred
B—Second Choice
C—Uneconomical



A suitable unit for comparing the performance of cables is P, which is defined as

(1) $P = LxI/dVx1000$

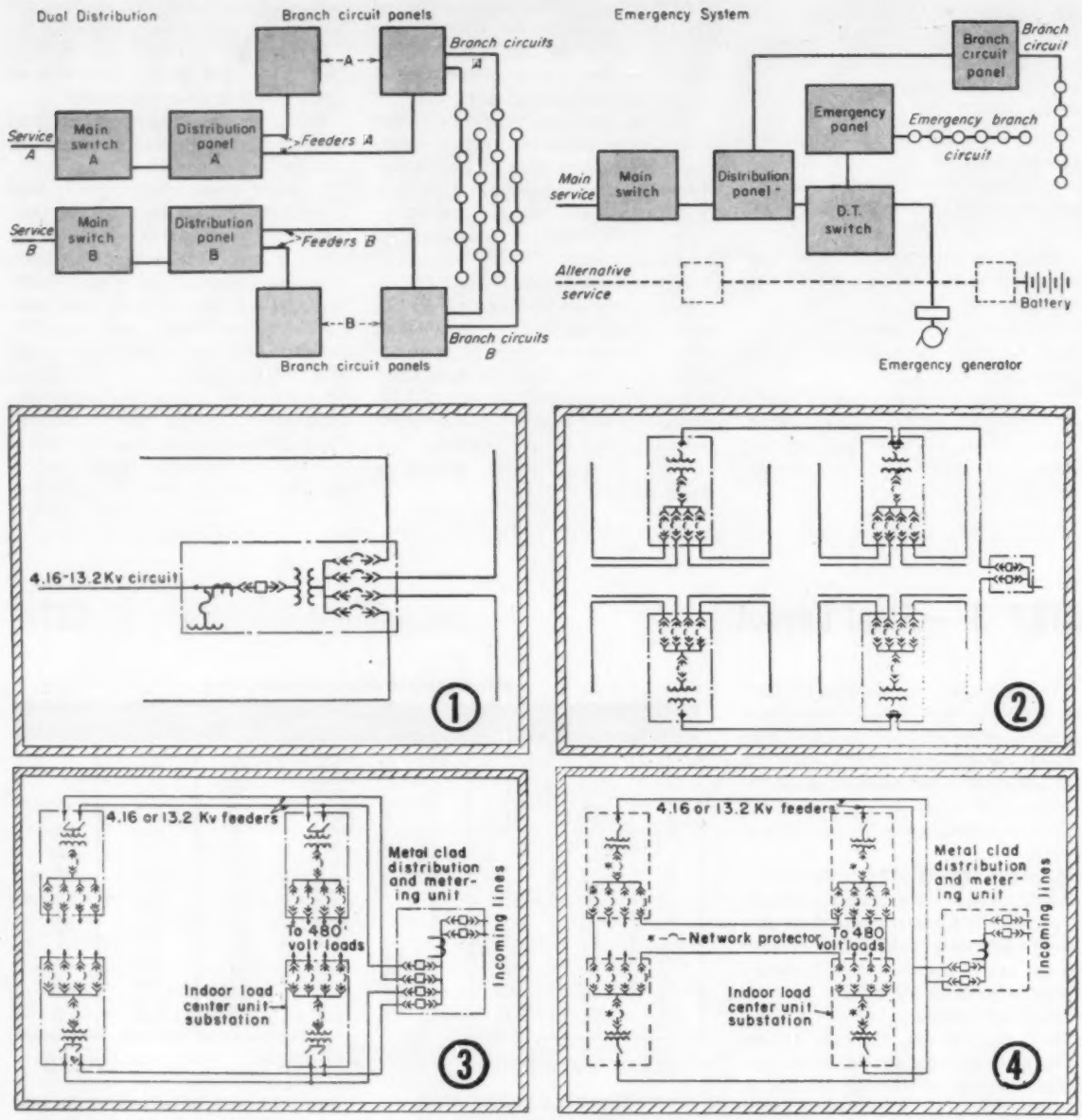
where, L = feeder length in feet
I = load current in amperes
dV = feeder voltage drop
(1000 is included for brevity)

Based on the average value of load power factor, 0.8 to 0.95, it can be assumed that voltage drop in a feeder is equal to the impedance drop, so that dV in Equation (1) becomes $LIZ\sqrt{3}/1000$, Equation (1) then simplifies to

$P = 1/(Z\sqrt{3})$

where, Z = ohms to neutral impedance per 1000 feet of feeder.

FIGURE OF MERIT, "P", provides ready appraisal of economy of various cable sizes for use in-multiple in feeders. Higher "P" adds up to lower voltage drop, reduced power losses and extra current capacity.



DISTRIBUTION SYSTEMS vary in type and application to particular modernization jobs. Two-service, dual distribution (top left) provides reliable, continuous service for majority of applications. Other systems are: 1. Radial, 2. Radial with load center subs, 3. Primary selective, and 4. Network.

3. Where spare circuits are available in panel, install surface raceway home run to existing J.B., run new surface raceway circuits.

4. Utilize any existing spare capacity in underfloor duct system, on the basis of Table 11.

5. Install flush duct in routed out floor channels with surface raceway home runs.

Of course, many other variations are possible. The idea is to utilize the greater permissible area of conduit occupancy for rewiring when structural characteristics make it impractical to increase the size of the raceway.

In all cases of increasing capacity by filling conduit to permissible occupancy all NEW wires should be pulled in the conduit. Insulation on old wire is invariably dried out and brittle. Pulling new wire in with the old agitates the old wires and may chip off or otherwise damage the old insulation. As a general rule, as much new wire should be pulled as possible. Where more wire is to be pulled in an existing conduit, best procedure is to tie all new wires to the old and pull the new in and the old out in one operation.

Still additional capacity can be gained by taking advantage of the smaller cross-section areas of thinwall-insulated wires compared to the cross-

section of rubber insulated wires. Tables 12 and 13 of NEC point up this advantage in rewiring existing conduit.

Standard methods and procedures should be used in the layout of new panels, home runs and circuit wiring whenever possible and practical. Use of surface raceway and special raceways greatly facilitates new work. If a louverall or luminous-ceiling lighting system or a hung ceiling is installed, new conduit can be concealed in the space above and sound system speakers and wiring can also be mounted there. Continuous or nearly continuous rows of lighting fixtures, surface or troffer units, provide excellent wireways for lighting circuits. For suspended lighting fixtures, surface raceway can be installed on the ceiling or set flush in channels routed out of acoustical ceiling tiles. For such lighting and receptacle circuits, existing home runs can often be used or new home runs can be installed exposed in hallway or similar area. Signal and communication circuits lend themselves to expansion by the use of surface raceway or underfloor ducts.

Expansion of panelboards can also be made in a number of ways. If spare circuit blanks are in the existing panel, there may be a certain amount of rewiring capacity, provided the particular type of overcurrent devices are available. In case of old knife switch and fuse panels, there are usually no spare blanks; and, if there are, the protective devices are not available. The panel should be replaced with a modern type. Other panels, however, may have spare circuits, with allowance for these circuits in home runs and feeders to the panel. When the existing panel offers no substantial spare capacity, a new panel of sufficient capacity for all circuits or a sub panel for added circuits must be installed. In many cases, a new panel of more circuits can be installed in the existing cabinet. In large areas, it will often be found that a sub panel is best located away from the existing panel, nearer to another load center of utilization devices.

FEEDERS: Increase of feeder capacity can also be approached in a number of ways, depending upon the amount of load increase to be served.

1. Riser conduits can be rewired for increased fill in accordance with Sec. 3466b, NEC. Voltage drop considerations, not more than 3% for power or heating loads, Sec. 2202 NEC, should be observed.

2. Existing spare riser shafts can be utilized for new feeders to handle added load. In some cases, it may be possible and advisable to run the new feeders to a new panelboard closer to a load center of new utilization devices.

3. The use of thinwall insulated conductors to replace rubber types R, RW, RH-RW, RUW and RH in some cases offers considerable gain in current carrying capacity.

4. In cases where change in type of service is made as part of the job, replacement of 2-wire 1-phase feeders with 3-wire, 1-phase on 4-wire 3-phase mains can be made.

In many cases, the extent of the load increase due to new lighting, air conditioning and/or other devices will require installation of additional risers and feeders to new panelboards. Good practice dictates that these new risers be oversized for future load growth, at least to the next larger size conduit than required. This will allow for at least 30% increase in capacity. Spare capacity should also be figured into the size of the new feeders.

Methods of installation of new conduit risers depend upon structural characteristics of the building. In some cases new risers can be run up stairwells, up unused elevator shafts or in space already used for existing risers. Horizontal runs can be made along ceilings in hallways or other areas in which appearance will not be marred by the exposed equipment. Busway feeders or cable troughs prove applicable and advantageous in many cases. In most cases, however, considerable mechanical engineering is necessary to solve these problems.

DISTRIBUTION: Provision of adequate wiring capacity for greatly increased loads may find economy and distinct advantage in the use of a different type of distribution than that which exists. Although extensive revision of a distribution system is not necessary on the majority of modernization jobs, the following discussion indicates the merits of typical office building distribution systems.

Distribution systems are divided into two general groups according to voltage of service—

1. Systems served at utilization voltages, and

2. Systems served at primary voltages requiring transformation to utilization voltages.

Group 1 systems are invariably of the simple radial type. A single service feeds a low-voltage switchboard, either directly or through high voltage switchgear and a transformer. Feeders radiate to various load centers throughout the building. In many buildings,

PERMISSIBLE CROSS-SECTIONAL AREAS OF CONDUCTORS

(In Percent Area of Conduit or Tubing)

	Number of Conductors				
	1	2	3	4	Over 4
Conductors (not lead covered)	53	31	43	40	40
Lead covered conductors	55	30	40	38	35
For rewiring existing raceways for increased load where it is impracticable to increase the size of the raceway due to structural conditions	60	40	50	50	50

See Sections 3466 and 3486, and Tables 12 to 19 — NEC

REWIRING EXISTING CONDUIT TO MAX. FILL

1. Permitted by NEC, Secs. 3466 & 3486.
2. Thinwall-insulated conductors occupy less space than rubber-covered conductors of same current capacity.
3. Use of thinwall-insulated conductors in conduit saves cost of additional conduit.

Examples:

Existing	Permissible Increase
4#8R/1"C Capacity—14.4kw	4#4T/1"C Capacity—25.2kw
4#6R/1¼"C Capacity—19.8kw	4#2T/1¼"C Capacity—34.2kw
4#1/0—2"C Capacity—45kw	4#4/0—2"C Capacity—70.2kw

Modernizing Office Buildings *(continued)*

where the total load exceeds several hundred kw, this system can be modified by dividing the secondary sub capacity among a number of load center subs on various floors. In the case of vertical extension of the utility net, primary feeders are carried to the load center subs. The resulting short low-voltage feeder runs afford better voltage regulation and lower losses. As a rule, 12 stories is the maximum height to which 120/208 volt-circuits can be carried. Of course this rule is limited by particular conditions and economy in a building.

One common variation which accents service reliability and safety in radial systems is the use of dual sets of secondary feeders to two panelboards which divide the circuit loads for one large area or even one entire floor. In this arrangement, alternate lighting fixtures or alternate groups of fixtures are fed from one panel and the balance from the second panel. A fault which kills the circuits on one set of feeders will not leave the area without any power. The alternate circuits will still be operating. In modernization work, this design advantage (see "Selecting Power Feeders," E. C. & M. March 1953) can often be dovetailed with existing conditions. The existing feeder can be used to feed half of the load and a new feeder installed to handle the other half.

Service continuity can be improved by the use of a primary-selective radial system. Two sets of primary feeders are carried to each secondary sub, at which point a selector switch enables connection of the sub to either of the primary supplies. Either of the primary feeders can supply the entire building load. Usually, however, the load is divided between the primary feeders under normal conditions.

The secondary-selective radial system is similar to the simple radial with a normally open low-voltage tie between pairs of substations. At each substation, one primary feeder is connected to one transformer and a second feeder to another transformer. Each transformer is normally connected to its associated section of low-voltage bus. The two bus sections are connected through a normally open low-voltage CB. Flexible and reliable distribution is the result.

A secondary network distribution system differs from the radial types in that ties between transformer secondaries are normally closed. In simplest form, the spot-network secondary substation consists of two transformers fed by separate sets of primary feeders. Both transformers feed the same secondary bus from which low-voltage feeders are radially distributed. A network protector between each transformer secondary and the bus is an electrically operated CB which will open if power starts to flow back to a transformer from the secondary bus. The protector automatically keeps itself closed on proper direction of power flow. Uninterrupted power supply and excellent voltage regulation are again the advantages, but at higher cost than for the radial system.

SERVICE: Increase in size or change of size, type and/or voltage of electric power service to a building is an important consideration in modernization work. Determination of the exact nature of service influences all other design considerations. The matter of service should be carefully resolved during preliminary planning.

A service entrance installation includes conductors, poles, conduits, fittings, and equipment for connecting building wiring to the utility's supply system. Conduit and cable service

VOLTAGE DROP

Two-Wire DC Circuits:

$$V = \frac{2k \times L \times I}{d^2} = 2R \times L \times I \qquad d^2 = \frac{2k \times I \times L}{V}$$

V = drop in circuit voltage (volts)
R = resistance per foot of conductor (ohms/foot)
I = current in conductor (amperes)
L = one-way length of circuit (feet)
d^2 = cross-section area of conductor (circular mils)
k = resistivity of conductor metal (cir. mil-ohms/ft.) ($k = 12$ for circuits loaded to more than 50% of allowable carrying capacity; $k = 11$ for circuits loaded less than 50%.)

Three-Wire DC Circuits:

$$V = \frac{2k \times L \times I}{d^2} \qquad V_n = \frac{V}{2}$$

V = drop between outside conductors (volts)
V_n = drop between one outside conductor and neutral (volts)
I = current in more heavily loaded outside conductor (amperes)
L = one-way length of circuit (feet)
d^2 = cross-section area of conductor (circular mils)
k = resistivity of conductor metal (cir. mil-ohms/ft.) (Use same values of k as in 2-wire circuits above.)

Two-Wire Single-Phase Circuits (Inductance Negligible):
Same calculations as for two-wire dc circuit.

Three-Wire Single-Phase Circuit: (Inductance Negligible):
Same calculations as for three-wire dc circuits.

Three-Wire, Three-Phase Circuits (Inductance Negligible):
Same calculations as for two-wire dc circuit carrying the same current, multiplied by 0.866:

$$V = \frac{2k \times I \times L}{d^2} \times 0.866$$

V = voltage drop of three-phase circuit

Four-Wire, Three-Phase Balanced Circuits (Inductance Negligible):

For lighting loads: Voltage drop between one outside conductor and neutral equals one-half of drop calculated by formula for two-wire dc circuits.

For motor loads: Voltage drop between any two outside conductors equals 0.866 times drop determined by formula for two-wire dc circuits.

drops on building exterior walls are commonly used for connecting to overhead transformer banks or overhead circuits supplying utilization voltages. Heavier services often are busway or enclosed bus systems. Low-voltage underground services may consist of cables in conduit or direct-burial cables.

Because types of services available vary greatly throughout the country, the local utility power engineer should be consulted. Important considerations which should be covered are:

Service equipment, including protective and disconnecting devices and accessory equipment, should be mounted in easily accessible, clean, well-lighted and dry location—not susceptible to damage or excessive vibration.

Modern power loads—elevators, ventilators, heating and air conditioning equipment, pumps, compressors, etc.—are often much larger than lighting loads, justifying switch to higher voltage service.

Higher voltage service may be the only answer to particular cases of extreme voltage drop on long feeders. Service and distribution at 277/480-volt Y, with local step-down transformers to feed 120/208-volt lighting and appliance circuits, is often economically advisable in tall-buildings. This is particularly true where installation of load center subs and primary distribution is not practical. There is also the practical possibility of using 277-volt circuits to supply lighting directly, with low-voltage control.

A changeover from 3-wire, 1-phase service to 4-wire, 3-phase may provide considerable economies in increasing wiring capacity, particularly where maximum use of existing wiring is required.

New services may be brought into the premises at a better point than the existing point of service entrance.

In general, the size and layout of a particular building will suggest the best type of service.

Tall Buildings—In tall buildings, an extensive installation of air conditioning and new lighting usually results in a power load which is often three or four times as large as the lighting load. An economical wiring system for tall buildings is best obtained by primary service supply and load center subs at several elevations. This primary supply may be part of the utility net or may be radial, depending upon utility requirements.

Large Buildings—Primary service to a primary-selective or secondary-selective radial system provides the high quality service, with minimum interruptions, required by large office buildings. A simple radial system is acceptable, however, where first cost is important.

Small Buildings—Service at utilization voltage from the utility's secondary mains is normally sufficient for a small office building. In such a case, a secondary sub in the building may be required by the utility. As long as voltage drops are reasonable a 120/208-volt radial system is practical.

Equipment locations and space allocations for service modernization require considerable engineering of structural details. The problem is further complicated by the need for service continuity during changeover. Changeover is best made over a weekend or after normal working hours, to minimize interruption of building activities.

ELECTRICAL LOADS FOR OFFICE LIGHTING SYSTEMS
(Watts Per Square Foot For 100 Footcandles)[1]

TYPE LIGHTING SYSTEM	Type Lamps → / Size Area →	INCANDESCENT Small	INCANDESCENT Medium	INCANDESCENT Large	FLUORESCENT Small	FLUORESCENT Medium	FLUORESCENT Large
INDIRECT (90%-100% Up)		48.0[2]	33.6[2]	25.9[2]	17.4[2]	12.1[2]	9.3[2]
SEMI-INDIRECT (60%-90% Up		42.6[2]	30.9[2]	24.2[2]	15.4[2]	11.1[2]	8.7[2]
DIRECT-INDIRECT (40%-60% Up)		30.0	24.3	20.2	10.8	8.8	7.4
SEMI-DIRECT (60%-90% Down)		25.0	20.2	17.8	9.0	7.3	6.4
DIRECT (SURFACE UNITS) (90%-100% Down)		24.4	20.2	17.3	8.8	7.3	6.2
RECESSED TROFFERS		—	—	—	7.9	6.8	6.1
LOUVERALL CEILINGS		—	—	—	10.6	8.5	7.5
LUMINOUS CEILINGS		—	—	—	11.0	7.9	6.6

NOTE: Data in Table above are based on average coefficients of utilization and maintenance factors for each lighting system shown, taken from the IES Lighting Handbook, 2nd Edition. Reflectances assumed are: Ceiling — 75%; Side Walls — 50%. Room Indexes used are as follows: Small — H, or 1.00; Medium — E, or 2.00; Large — B, or 4.00.

[1] To obtain "Watts per Sq. Ft." for lighting intensities other than 100 footcandles, multiply Table values by percentage that desired intensity is of 100 footcandles.

[2] Lighting intensities in excess of 50 footcandles, using typical "Indirect" or "Semi-Indirect" lighting systems on flat ceilings, are not recommended.

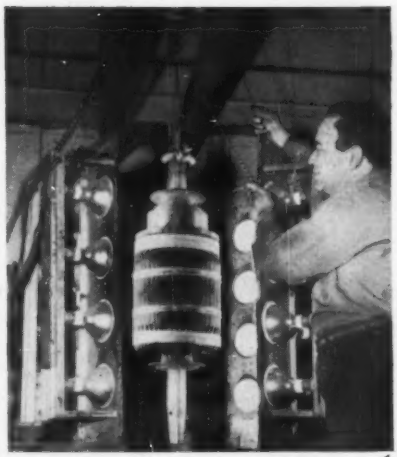
POWER LOAD STANDARDS — WATTS/SQ. FT.

	AIR CONDITIONING Low	AIR CONDITIONING Average	AIR CONDITIONING High	ELEVATORS (Based on Usable Office Space) Low	ELEVATORS (Based on Usable Office Space) Average	ELEVATORS (Based on Usable Office Space) High
Office Building	3.4	4.2	6.0	0.6	1.0	1.5
Office Suites	2.7	3.4	4.7			

1 Restaurants and grilles are finding an increasing use for infrared lamps to light as well as heat meats and other foods placed on combination display-serving counters in cafeteria or buffet-type eating spots such as Ireland's Mart in Portland, Oregon. This particular restaurant finds that a bank of 14 250-watt R-40 lamps keeps food piping hot, presents meats in mouth-watering, temptingly warm colors, and promotes appeal to customers. An electric dry-heat well beneath the pans, normally operated at the lowest heat possible, is run in combination with the infrared lamps for maximum penetration of warmth. Lamps are wired alternately so that half of them may be switched off when not required.

15 Case Studies of Electric Heating

Electric heating sources and methods are receiving ever-increasing recognition, for their advantages are many and their variety makes it possible to satisfy exact demands. Here are some specific examples where infrared lamps, all-metal radiant units, encased elements and resistance heating cables have paid big dividends in efficiency, safety and speed of operation.

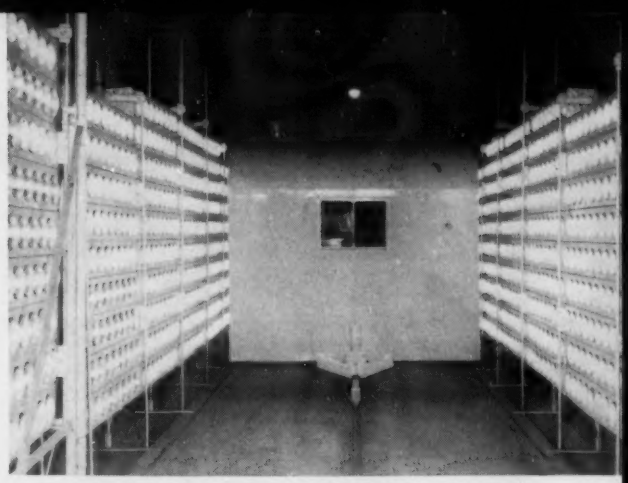


4 The Torq Industrial Power and Manufacturing Company in Cleveland, Ohio, estimates that infrared lamps have cut motor baking time by at least half. Their unit is a 2-section flexible assembly, with each section containing twelve 250-watt R-40s and with reflectors so positioned that only the frosted lenses protrude from the front. Temperatures may be easily regulated by turning lamps on or off in pairs, or by varying the distance between the reflectors and the motor being baked. Torq uses this mobile assembly for both pre-heating and after-dip baking, with baking time dictated by the size of armature or stator being treated.

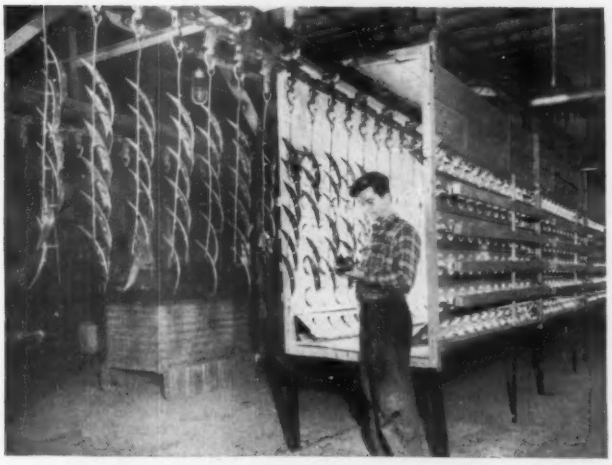
DEFINITELY on the upswing are applications for electric heating—in factories, commerce, the home and on the farm. New uses are being realized daily, for advantages of electrical heat are being recognized by increasing numbers of plant engineers and contractors, shop owners and consultants, architects and home owners. This is not surprising, for (1) combustion gases are absent, due to the non-existence of an open flame, (2) heat losses are lower, due to the concentration of heat at the actual point of use, (3) temperatures adjacent to heating areas are reduced for the same reason, (4) greater safety is provided for products, equipment and operating personnel, due to positive protective devices and controls, and (5) both installation and maintenance are simplified, due to the compact, light-weight, rugged construction of electric heating units now on the market.

With this wide selection of heating sources and methods available, it therefore becomes possible to utilize heat in its most effective form for each specific application such as convection heating for confined spaces, ovens and kilns; conduction heating for molds, irons and hot plates; and immersion units for liquid storage tanks, processing kettles, sterilizers and the like.

2 Hoffman-Stafford of Chicago uses infrared lamps to speed the drying of tanned leather. In their installation, however, they use G-30 clear glass 375-watt lamps with 11-inch square gold-plated supplementary reflectors, with lamps located 18 inches above the surface of the metal-mesh chain-driven conveyor. This conveyor carries skins the length of the installation in 2½ minutes; skins reach a maintained temperature of 120 degrees F and, due to the even distribution of energy along the entire extent of the drying conveyor, skins are left soft and pliable. Three banks of 60 lamps each and one long bank of 220 lamps results in a connected load of 150 kv. Lamps are wired in groups of 20, with a fused breaker and separate armored-cable 7.5 kw circuit for each group.



3 The Indian Trailer Company of Chicago uses a total of 908 reflector R-40 industrial G. E. 250-watt infrared lamps to bake the exterior enamel coat of their trailer chassis. These lamps are spaced on 3-inch centers horizontally and a foot vertically, with 8 lamps to each galvanized housing unit. Units are clamped to vertical supports in tiers of 10 (for side sections of the infrared enclosure) or 9 (for end sections which are folded in to complete the oven arrangement after the trailer is positioned for baking). When end sections are in place, the frosted lamp lenses are approximately 11 inches away from the enameled surfaces of the trailer, and heat is confined and reflected by the fronts of the perforated lamp housings. The total connected load is 227 kw, and control of lamps is by sections.



5 Empire Plow Co. of Cleveland uses a 27-foot-long tunnel in which protective varnish coatings are baked on 2600 plow teeth per hour. This is accomplished in 6 minutes, whereas this drying cycle formerly required 1½ hours. The tunnel incorporates 432 lamps of the 250-watt size, with 144 lamps in each of 3 sections. Lamps may be switched on or off by section or by row, giving the oven maximum flexibility to meet varying operational conditions. Empire's plant engineer, L. L. Slygh, maintains that "the infrared tunnel-conveyor installation is one of our best foremen. It keeps things moving along on an exact time schedule and production has doubled since its adoption. Because infrared lamps have no warm-up period, there is no delay or piling up of parts. Because the installation is compact, the plant now has additional space for other purposes. Since there are no exposed heat sources in the shop proper, greater safety is provided to personnel."

6 The use of infrared lamps also solved an annoying problem during the laying of mastic floor tiles in Bond Clothing's Rochester Plant for, when tiles were put down on a cold concrete slab, the 12-inch squares had a tendency to curl up slightly along the edges. This was due to the fact that the mastic adhesive was not holding properly to the chilled base. However, by constructing a mobile heating reflector, consisting of 64 R-40 infrared 250-watt, arranged in a square pattern with a 7½-inch center-to-center distance between lamps in both directions, sufficient heat was provided to obtain a positive bond. In this unit, lamps are about 4 inches above the floor, the assembly is easily moved around on its castered legs, and the heating cycle is approximately 2¼ minutes. After this heating, tiles are pressed firmly into the mastic adhesive by means of a roller that smooths all joints and leaves the floor in the desired freed-of-curls condition.

7 Car owners everywhere should be interested in this compact G.E. engine heating unit that may be permanently installed in a "freeze-out" plug opening in the engine. The unit, specially designed for Chevrolets, may be plugged into any standard 115-volt outlet by means of a flexible connection cord and, by maintaining a constant, low level of heat in the engine, it gives quicker starting, greatly reducing the load on the engine and battery caused by congealed oil and slow circulation. Even during the coldest winter months, this midget heater provides fast starting for contractor service trucks and private cars.

Another method for obtaining fast starts on cold mornings is to slide an upturned R-40 infrared lamp under the motor when the car is driven into home garage each night. The lamp is suitably supported and protected, and the extension cord may be plugged into a receptacle, the circuit for which is controlled remotely from inside the home. With this arrangement, the car owner can press the circuit switch several minutes before going out to the garage and, upon his arrival there, the motor will have lost its over-night chill.

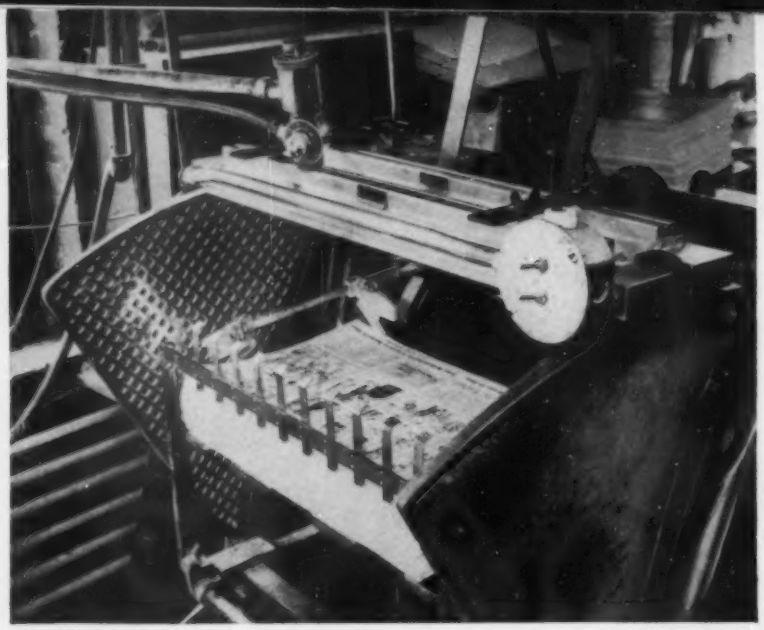
9 Effective means for preventing the formation of ice and snow on drives, runways, walks or steps is to embed flexible heating cables directly in the concrete. This method was adopted at the Bucyrus-Erie plant at South Milwaukee, Wisconsin, where four concrete runways, ranging in length from 100- to 275-feet in length and averaging 10-feet in width, were equipped with a total of 40,000 feet of G. E. resistance heating cable. To supply correct voltage for non-standard lengths of cable, special transformers were built by the Milwaukee Service Shop. These secondary voltages ranged from 180- to about 500-volts, depending upon cable length.

In this installation, heating cable was laid on wire mats, about 3 inches below the level of the finished concrete slab, and they were spaced at about 3-inch intervals. Tile drains on either side of each runway provide adequate drainage for the melted snow. This installation is effective throughout the winter; on one severe occasion removing a week-end of snow in a few hours although outside temperatures were 11 below zero.

Flexible heating cable may also be used along gutters and eaves of homes, directly in the earth of plant and flower hot-houses, along the inner edges of store show windows to prevent condensation forming on the glass, in storage rooms to maintain a moisture-free atmosphere, under wooden platforms or rubber mats in unheated shops, in poultry brooders or watering troughs for farm use, or around pipes, tanks or stacks to prevent freezing, hardening or condensation of the enclosed liquid or vapor.

8 The use of Thermwire may also be noted beneath the lower truss members of a highway bridge at Applewold, Pa., where it is used to prevent the freezing of water pipes. Since one city water supply serves both sides of the river, and since the strategic location of the bridge recommended it as the logical route for transporting water, this means was adopted. The Thermwire prevents freezing during winter months. Power circuits for these heating wires are carried in conduit secured beneath the pedestrian walkway along the side of the bridge, and flexible drops connect the Thermwire terminals every ten feet. This installation operates on 220-volt power. In these two views, the wire loops may be noted wrapped around the water pipe beneath bridge stringers.

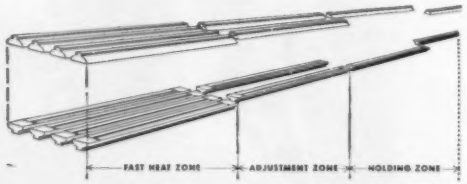
10 As another illustration, process machinery housings at E. I. Wiegand's Pittsburgh, Pennsylvania, plant are wrapped with Thermwire, then covered with a layer of insulation to prevent condensation from falling into material being processed immediately below. Since Thermwire may be ordered cut in standard lengths (80 feet, 115 volts, 400 watts; 160 feet, 230 volts, 800 watts) or specified in nonstandard lengths for special applications, versatility of application is provided, and exact heating requirements can be satisfied.



11 Another application for metal radiant heating units is in connection with printing presses, as evidenced by the experience of the Advance Printing Company of Boston, Mass. When one of their old 1540-watt open-coil electric heaters became obsolete and ineffective due to long use and age, it was replaced by two 800-watt Chromolox units which were mounted directly above the delivery platform. Heater lengths were selected so that the complete width of the platform was covered, and the units were secured in place by means of two hinged steel brackets, thereby permitting the heaters to be swung back out of the way when desired.

These units quickly dry 12¼-by-20-inch printed sheets as fast as they settle on the platform and, except for unusually difficult jobs, a single 800-watt unit is sufficient. This results in faster, better jobs at less wattage than previously required. Moreover, short circuits, formerly caused by broken resistor wires in the open coil heaters dangling down and touching the metal frame of the platform, have been eliminated. Of course, the danger of ignition, which is ever present with fuel-burning heaters, is absent, and, since the electric units consume no oxygen nor create toxic gases, working conditions are improved.

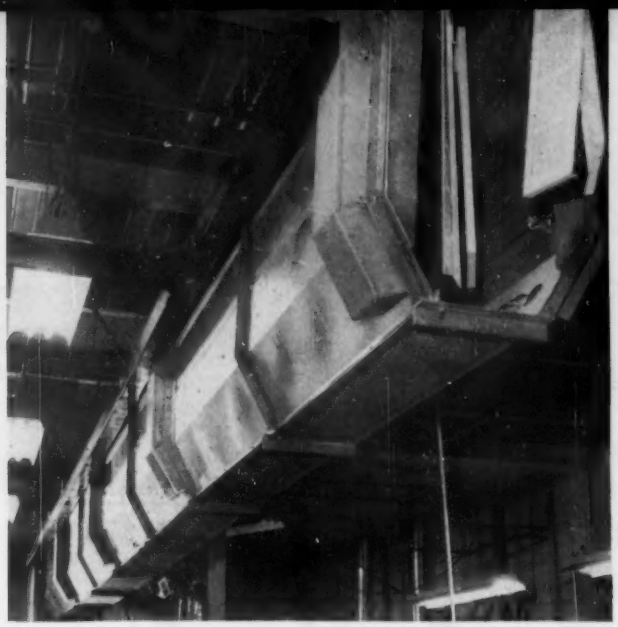
12 Keeping food at proper serving temperatures in restaurants and cafeterias is also a job for sheathed tubular radiant heaters, and the Golden Star Dairy of East Liverpool, Ohio finds that two 800-watt units, installed end-to-end above their pickup counter, keep food appetizingly warm even during rush-hour peaks when waitresses are frequently delayed by writing up orders. Units are mounted with small angle irons and studs to the serving counter hood, while waitresses are protected against inadvertent burns by a wire grille.



14 Using the radiant heating unit, the Lien Rubber Manufacturing Company of Los Angeles, California, improved their overall plant efficiency by more than a third, now curing 400 molds of latex foam sponge rubber daily, in two 8-hour shifts, whereas it formerly required three 8-hour shifts to produce 384 molds a day. To cure their product, latex foam compound is poured into aluminum molds which are conveyed through a 42-foot-long zoned all-metal radiant infrared tunnel; the first zone consisting of four parallel rows of radiant units both top and bottom, the second zone consisting of two rows above and below, and the third zone fitted with a single row of units above and below the zone through which the slowly-moving molds are conveyed. In all, the tunnel utilizes thirty 1.8-kv Chromalox heating units, for a gross connected load of 54-kw. In the three zones, the molds are (1) heated rapidly, (2) adjusted to a constant 200-degrees F and (3) maintained at this temperature by means of mold thermostats and input controllers.

This wire grille completely encloses the heating elements as a protective measure. Units are operated continuously for 16 hours a day, from 8:00 a.m. to midnight, maintaining the heat and moisture in the food and keeping plates warm. This heating is provided without objectional glare; the remote possibility of broken glass dropping into the food is eliminated; cooking and serving processes have been made efficient; and customer complaints due to cold food have been completely eliminated.

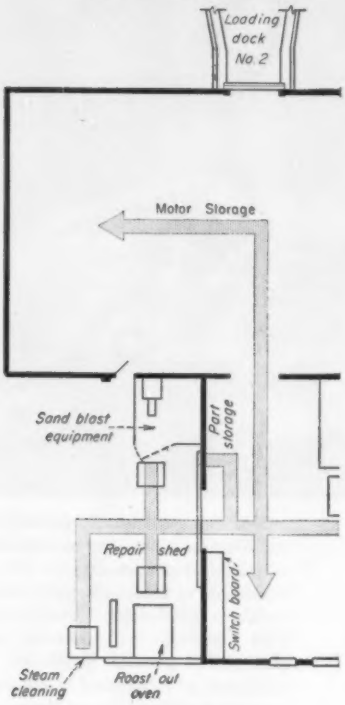
Nickle-chromium resistance wires, embedded in heat-conducting magnesium-oxide and sheathed in protective metal casing, may be used in a great variety of forms, making them uniformly applicable for strip, tubular, cartridge, cast-in, fin or immersion heating units.



13 Chromolox units are used by the National Grille and Register Company, Cleveland, Ohio, to thoroughly dry paint-dipped grilles and registers. Their 36-foot baking oven is mounted to ceiling beams, leaving floor space beneath it free for other purposes. The installation includes 30— 3-kw rod-type infrared elements, wired by 15 circuits in groups so as to promote temperature flexibility. Wiring is carried in square metal raceways along the ceiling adjacent to the tunnel, while roll-back sides on the tunnel permit access to all parts of the heating system for periodic inspection and maintenance. In operation, grilles are progressively carried via conveyor chain to an electric vapor degreaser tank, a paint-dip tank, up to and through the drying tunnel, then beneath a 20-inch circulating fan where pieces are cooled down for manual handling. Grilles range in size up to 30-by-30-inches and tunnel capacity is 700 grilles per hour. This new production rate is three times greater than was possible with gas-fired batch ovens.

15 Ice and snow accumulations on the microwave parabolic antennas of T-V Station WRGB in Schenectady, N. Y., are prevented by an installation of General Electric Calrod heaters. These electric heaters rest on asbestos pads in circular units secured to the rear of antenna reflectors and snow, sleet or hail is instantly melted when it strikes the warmed surface of the reflectors. Television transmission is thereby kept at a constant level of performance.

FLOOR PLAN shows



Service Shop Features Efficiency

New quarters of Electrical Equipment Company's Augusta, Ga. branch include motor repair shop, electrical wholesale warehouse, and office areas, was built around modern design and layout ideas, and uses efficient equipment and repair techniques.

By E. Dalton White

WHEN the Electrical Equipment Company decided that the cramped facilities of its branch repair shop in an old downtown building in Augusta, Ga., were inadequate and inefficient, it set out to design and build a modern structure specifically geared to its own needs and requirements. As a result, its new quarter-million dollar building in Augusta houses one of the most modern repair shops and warehouses in the entire Southeast.

Electrical Equipment Company's headquarter's office is in Raleigh, N. C., and the company maintains two other branch plants in addition to the Augusta plant. One is in Richmond, Va., and the other is in Laurinburg, N. C.

The Augusta branch operates two businesses. One is a motor repair shop business in which electrical apparatus of all types are repaired and tested. The other is a wholesale electrical supply business. Half of the new 210-ft. by 100-ft. building is for the repair shop, the other half for the wholesale warehouse. In front and part of the building is a 35-ft. by 73-ft. modern office area. These offices used redwood panel walls with acoustical tile ceiling and asphalt tile floors. Fluorescent lighting provides a minimum of 35 footcandles. The offices are air-conditioned for comfort and provided with automatically controlled heating.

Before designing this new building, F. E. Cook, assistant manager of the Augusta branch office, visited other service shops in Philadelphia, Pittsburgh and Chicago, and throughout the Southeast, to obtain ideas on equipment, shop layout, repair methods, etc. These ideas were then studied in detail and many of them were incorporated in the new facilities.

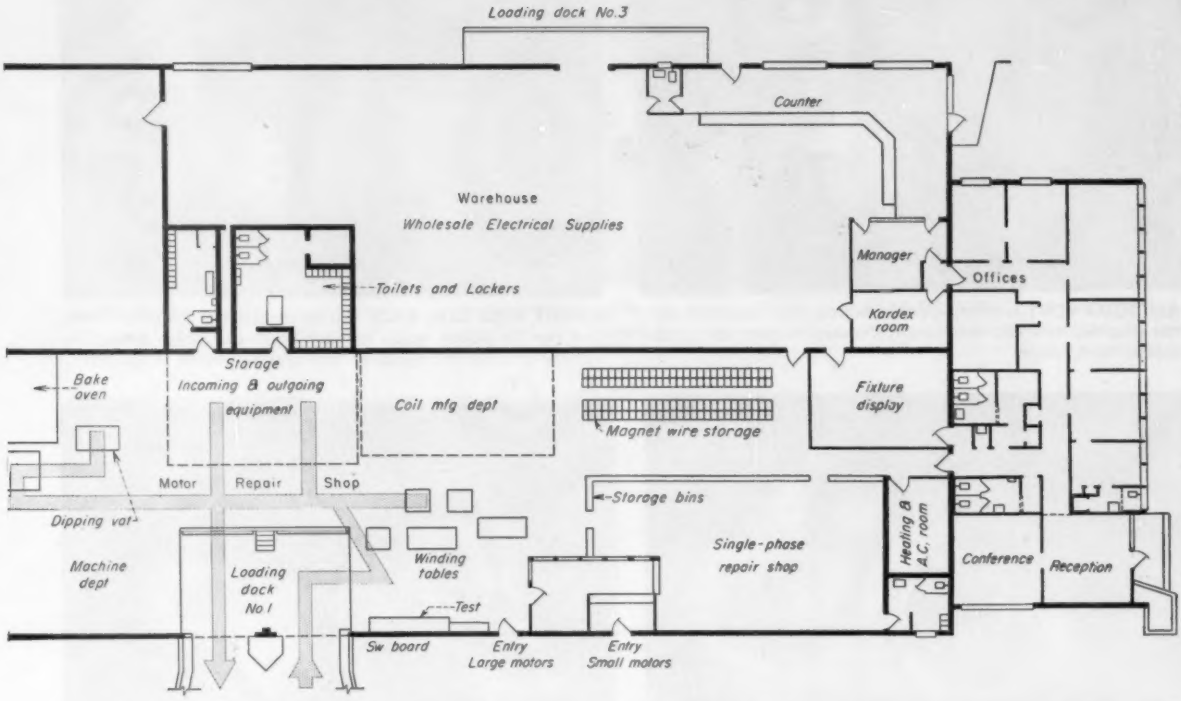
"Visit as many shops as you conveniently can before designing your own" is Mr. Cook's advice. "There are so many new devices and ways of increasing shop efficiency that it pays to assemble as many ideas as possible".

Electrical Equipment Company had to compromise on its location. The motor repair facilities might well have been located in the suburban area where property values are less. On the other hand it was desirable for the electrical supply business to be located in close proximity to the business district.

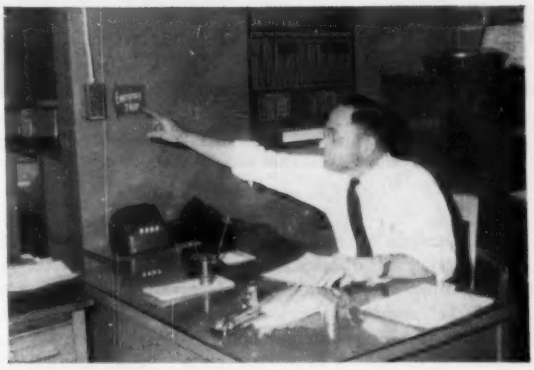
The location selected (1441 Greene Street) was a happy choice, for there is ample space for the 23,555 square foot building and for future expansion. There is access to highways and plenty of parking area. The building is bounded on three sides by city streets, and a driveway at the rear of the building provides all-around access.

In designing the building, many factors were considered, and important new facilities deemed necessary were provided. Here are some of those considerations:

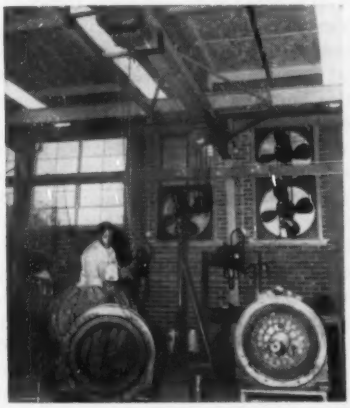
offices, electrical supply dept. warehouse, motor repair shop facilities and work flow.

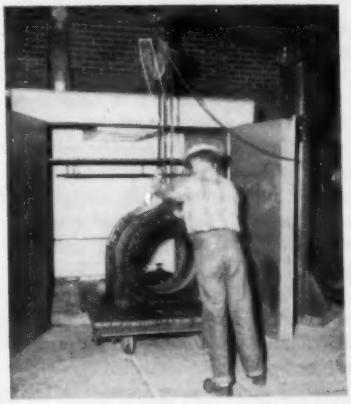


MANAGER of Augusta branch is T. R. Duncan, (right), shown here with his assistant, F. E. Cook.



EMERGENCY TRIP SWITCH for safety is conveniently located beside desk of George F. Bullock, repair shop supt.

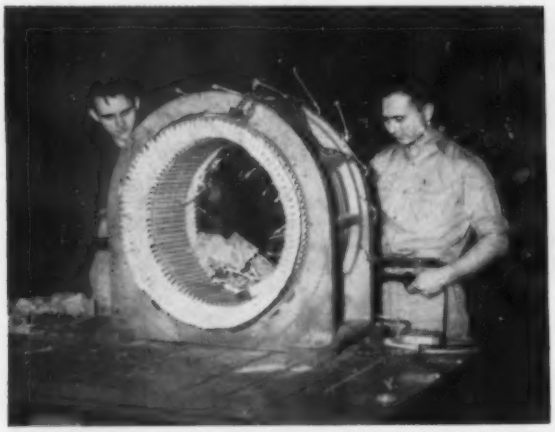




OVERHEAD ELECTRIC HOISTS make handling of motor frames, motors and other heavy equipment around the shop an easy job. Pushbutton controls simplify operation of heavy-duty cranes. Wall fans provide adequate ventilation.

ALL EQUIPMENT is steam-cleaned before it is routed through the shop for overhaul and repair. Removal of dirt and grease makes work easier.

HANDY WIRE REEL RACK was constructed of Unistrut frame and can be moved easily or additional reel spaces added. A variety of sizes and types of wire can be placed in the rack.



WORK BENCHES were specially-made, and specifically designed for the various types of work to be performed on each. Bench shown allows access all around without crowding.

SMALL MOTOR repair shop is maintained in a separate section and operated as a self-contained unit. Modern equipment in this compact area promotes efficient operation.

1. Materials handling equipment must be good and of labor-saving type.

2. Loading and unloading platforms should be conveniently located, for minimum handling of equipment and supplies.

3. Provide area outside building for cleaning, stripping, sand-blasting, painting, etc. (a mild climate in Georgia makes these operations economical and practical on the outside of the building).

4. Testing facilities to be adequate and conveniently arranged:

5. Lighting and ventilation to be good and adequate.

The building as finally designed incorporated these and other important factors in the building layout and facilities.

There are adequate truck entrance and exit facilities. Platforms are built at truck body height so that equipment can be loaded and unloaded easily.

While there is easy access to all parts of the building, the repair shop and the electrical wholesale business have been separated one from the other, and each has its own warehouse sections and loading platforms.

The half of the building that is occupied by the motor repair section has been carefully designed for all necessary equipment for repair, overhaul and testing of electrical apparatus. The fractional hp motor department is located in the front part of the building with a separate entrance, and with all its receiving and deliveries handled at this point. It is completely independent from the large motor repair shop.

The shop area devoted to the repair of large motors occupies the greater portion of the motor section, and extends to the rear of the building and the partly roofed apron where cleaning, stripping, sandblasting and painting operations are performed.

In this service area there is a Lany Company bake oven and a Pangborn Corporation sand blaster. A steam generating unit provides additional cleaning facilities.

The main body of the shop contains facilities for coil winding and motor overhaul, in addition to the dipping vat, the bake oven, balancing equipment, and facilities for electrical testing. An important feature is the plug-in strip along the test wall which provides any number of desired outlets.

Labor-saving materials handling equipment abounds at every important operation. There is a 5-ton Harrington electric overhead crane which travels the entire length of the shop, and extends in the rear of the building over the service apron. There is a 2-ton Shepard-Niles electric overhead crane for handling smaller items. Both cranes are controlled by pushbuttons.

A crane is installed centrally to reach both the dipping vat and the bake oven with one swing, so that equipment can be moved from dipping vat and easily placed on a dolly to be rolled into the bake oven.

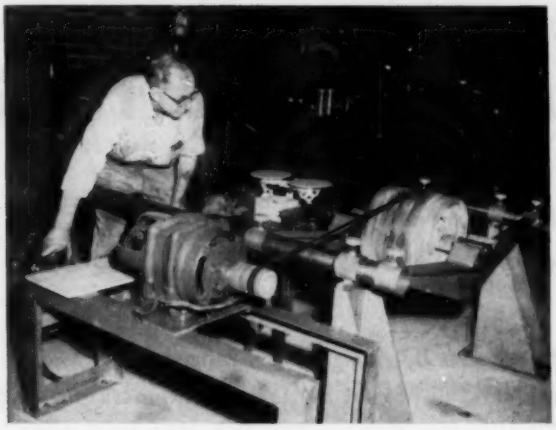
A crane transfer allows the overhead hoist to be transferred from the shop crane to a crane beam in the used motor and equipment storage area,

SAND BLAST machine in outdoor repair shed protects operator, permits visibility through plastic window.

BAKE OVEN in open air repair shed is gas-fired, and equipment is moved into and out of it by the electric crane hoists.

CAGED-IN AREA is used for stocking small motor and equipment parts. Door behind attendant leads to warehouse.

NEW PANEL SWITCHBOARD is used for testing all electrical equipment. It incorporates many features with full consideration for safety, was shop-designed and constructed.



SENSITIVE balancing machine allows for accuracy in motor balancing before being placed in the motor frame. All motors are mechanically and electrically tested before okayed.

separate from the repair shop and a part of the warehouse storage.

A motor received for repair at the shop is unloaded on the right hand side of loading dock No. 1 (See floor plan). It is removed from the truck with the overhead crane and momentarily placed at the winding department switchboard for testing. Then it is moved down the center of the shop to the rear for disassembling, after which the parts go in different directions.

The stator, which will be rewound normally, goes to the outside ramp at the rear of the shop. First, it goes into the roast-oven, then to the sandblast room where the old winding is removed and the stator is sandblasted.

The rotor and end brackets go from the disassembling area to the steam cleaning area outside the rear of the shop where they are thoroughly cleaned. Then they are returned to parts storage, or to the machine department for machining.

In the meantime, the sandblasted stator goes back to the front of the shop to the portable winding tables. Here it is again tested while on the table. It then goes to the bake oven car where it is preheated, and then swung with the mast-jib crane over to the dipping vat, dipped, and returned to the bake oven car for baking.

One of the prides of the company is the shop-made test board, which provides test for voltages from 70 volts to 600 volts, three phase, open rotor test, volt meter, dual arranged scale for high and low, dual arranged ammeters. There are flash signal lights to denote when the board is energized and a signal light over each instrument. The board is wired so that it is impossible to have more than one voltage at any time.

The high potential test is rigged with two switches in series, so that both hands must be on the stick to test. This is a safety precaution. In addition, a red flash signal on the board indicates when the high potential is being conducted.

As a further safety precaution, there are three emergency trip switches located at strategic points—one at the superintendent's desk, and one at each of the two test switchboards.

While Electrical Equipment Company officials know that there are other pieces of equipment which they might have had installed, the ones now in service provide for their many needs and promote efficient operation. When the time comes for installation of additional equipment, there is ample space for it and it will fit nicely into the existing production lines.

T. R. Duncan is manager of the Augusta branch; F. E. Cook is assistant manager; and George F. Bullock is superintendent.

Officers of the Electrical Equipment Company, which serves industry throughout the middle-Atlantic states. are as follows: J. M. Cutliff, President: D. R. Ponton, Vice-president; T. R. Duncan, secretary, and manager of the Augusta branch; H. B. Upton, asst. secretary; T. T. Thomas, treasurer: and H. I. Lamb, asst. treasurer.

HOW THE MARKET IS DIVIDED Shipments by Percent of U.S. Total, 1953

	Wired Homes Jan. 1, 1954	%	Washers 1st 8 mos.	Ironers 1st 8 mos.	Dryers 1st 8 mos.	Refrigerators 1st 9 mos.	Freezers 1st 9 mos.	Ranges 1st 9 mos.	Water Heaters 1st 9 mos.	Television 1st 9 mos.	Radio 1st 9 mos.
NEW ENGLAND	2,865,234	6.57	6.29	3.86	4.20	5.68	4.19	7.51	5.43	6.35	6.33
MIDDLE ATLANTIC	8,734,303	20.04	18.99	20.72	17.95	21.47	14.60	14.19	14.70	20.97	24.50
EAST NORTH CENTRAL	9,104,164	20.89	22.17	34.39	37.00	20.56	22.02	19.70	23.01	21.43	23.37
WEST NORTH CENTRAL	4,172,545	9.58	8.30	11.10	11.22	8.05	14.34	7.69	10.10	9.07	7.61
SOUTH ATLANTIC	5,770,559	13.24	13.06	7.22	5.59	15.29	13.29	22.49	26.53	12.03	12.32
EAST SOUTH CENTRAL	2,731,895	6.27	6.34	2.07	2.39	7.19	7.35	10.66	6.87	5.15	5.05
WEST SOUTH CENTRAL	3,952,065	9.07	9.43	5.34	3.71	9.32	12.60	3.74	1.90	10.10	7.63
MOUNTAIN	1,440,895	3.31	3.34	4.12	2.80	2.94	4.70	4.19	4.01	3.32	2.71
PACIFIC	4,808,888	11.03	12.08	11.18	15.14	9.50	6.91	9.83	7.45	11.58	10.48
TOTAL	43,580,548	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Appliance and TV Sales Top $7-Billion in 1953

Recoveries by refrigerators, ranges, water heaters, plus gains by new items like dryers, freezers, disposers, and air conditioners put industry 18.4% ahead of previous year

By Robert W. Armstrong,
Managing Editor, "Electrical Merchandising"

FOR the electrical appliance and radio-TV industry, 1953 was a good year. The readjustment predicted in some quarters for the second half of the year never showed up. Television sales, despite the confusion caused by the imminence of color, found enough markets in new station areas to make a gain. And dealers, despite credit troubles, price cutting and the highest rate of retail failures since the depression years of the 1930's, benefitted from the biggest volume of merchandise since 1950, the all-time record year.

According to estimates made for its annual statistical issue by *Electrical Merchandising*, appliance and radio-TV sales increased 18.4% for a total dollar volume of $7,301,939,750. Appliances alone (not counting kitchen cabinets, sinks, lamp bulbs and tubes) rang up their biggest year in history with a 20.2% gain to $5,031,215,900. TV and radio jumped 14.7% to $2,270,723,850—highest since 1950.

Aided by continuing high consumer incomes and full employment, nearly every electrical appliance made substantial gains. But some of the old standbys probably will never again account for such a large share of the overall market while some of the newer ones loom increasingly important in the column of percentage of industry volume.

Take refrigerators, for example. According to *Electrical Merchandising's* estimates, 1953 sales of 3,775,000 units meant a 5.7% increase and put this appliance's saturation at 90.4% of the nation's 43,580,000 wired homes. But in each year from 1948 through 1951 refrigerators totaled well over four million units. Now take a look at room air conditioners. Their 1953 sales were 1,075,000 units, a 194.5% increase over 1952, and saturation now stands at 3.2%. In 1952, the room cooler's biggest previous year, sales were only 365,000 units.

Index to Sales

For some appliances saturation is an important index to 1953 sales, even more important than how long a product has been on the market. Look at electric ranges. Their sales of 1,300,000 units represents a 22.6% increase, but saturation is still low enough to permit much more market expansion —25.9%.

The parallel still holds with food waste disposers. By comparison with ranges they are brand new on the market, but sales jumped 35.8% for a total of 353,000 units and saturation moved up to a still-small 3.9%. Electric storage water heaters—which have had long years of struggle to attain consumer acceptance—moved forward 19.7% for total sales of 862,000 and a new saturation figure of 14.7%.

But some appliances with low saturations didn't do so well. Ironers, which still have to be demonstrated to be sold, were one of the few appliances to decline. Sales of 170,000 units represented a 19.6% loss. Clothes dryers, one of the newer appliances with a bright future, disappointed. Electric models gained 10.8% for a total of 525,000; gas units fell off 0.6%. Sales of both types together totaled 685,000, a 7.9% increase. Dishwashers, often called the industry's "sleeping beauty" showed little sign of waking up. Sales of 180,000 units represented

a 2.9% increase and brought saturation up to 3.2%.

Freezers suffered a bit from the ill effects of the bad publicity accorded fly-by-night food plans in 1953 and sales, which might otherwise have soared, went ahead only 5.3% for a total of 1,200,000 and a new saturation of 13.7%.

The advance of the automatic washer is another example of the new replacing the old. Automatic sales jumped ahead 17.3% for a total of 1,975,000 machines, but conventional type washers fell off 3.6% for a total of 1,525,000.

Housewares Get Hot

As with major appliances, some of the biggest gains in electric housewares were made by new appliances. Broilers, with a 203.7% increase and sales of 1,320,000 units, led the way. Deep fat fryers jumped 73.8% for a figure of 2,650,000. Coffeemakers registered a gain of 22.8% and sales totaled 3,685,000. Steam irons, rapidly replacing both automatic and non-automatic dry irons, jumped 38.4% and set a new record of 3,950,000.

But not all the gains were made by new appliances. Roasters, for example, went ahead 10.6% and sold 470,000 units. Toasters gained 6.4%; heating pads, 21.7%; fan-type heaters, 36.2%; waffle irons, 5.0%; window ventilating fans, 30.7%; wall and ceiling ventilating fans, 16.2%.

Growth of the Replacement Market

During 1953 the importance of saturation manifested itself in replacement and trade-in figures. Generally speaking, those appliances with the lowest saturation and the greatest public appeal made the best sales records. Refrigerators, which as a household necessity will always be sold in volume, have a high replacement and trade-in factor—which complicates the selling job. In 1953, according to 187 dealers who responded to *Electrical Merchandising's* survey, 74.6% of all refrigerator sales went to homes already possessing refrigeration, and 47% of all sales involved a trade-in. Ranges, with a lower saturation, did better. Only 44.1% of sales went as replacements to range owners and 27.8% involved a trade-in. Replacements figured in 37.2% of water heater sales and trade-ins in only 6.0%. Ironers, which have trouble finding new homes despite their low saturation, were replacements in 12.8% of sales, although trade-ins were taken in only 2.2%.

Best Markets

The table on these pages shows which of the country's nine geographic regions absorbed the highest percentages of various types of appliances, but, according to the reports of 224 utilities, these do not necessarily represent the areas which made the most sales in proportion to the number of customers. For example, the table shows that the Middle Atlantic states were the nation's best market for refrigerators with 20.56% of industry volume. But in sales per 1,000 customers, the South Atlantic region (Del., Md., D.C., Va., W. Va., N. C., S. C., Ga., Fla.) is the outstanding refrigerator market with an average 114 sales per 1,000 domestic utility customers. Room air conditioners sold best, as might be expected, in the hot climate of the West South Central region (Ark., La., Okla., Tex.) with an average of 62 per 1,000—a score which wasn't even approached by the next best region, the East South Central (Ky., Tenn., Ala., Miss.), which had 36. Ironers sell best in the Mountain states.

What's Ahead in 1954

In the light of 1953's better-than-expected performance and economists' predictions for a lower level of business activity in 1954, it is not surprising that the appliance industry looks for some declines this year. Economists say it will be 5 or 6%. But even with a 5% decline, 1954 will still be a good year, good enough to take a place with the rest of the "supernormal" postwar years.

APPLIANCE SALES: NEARLY EVERYTHING WAS UP

	1953		1952		% Change	
	Number Sold	Retail Value	Number Sold	Retail Value	Units	Value
Air conditioners, room	1,075,000	$420,530,000	365,000	$141,758,000	+194.5	+196.7
Bed coverings	890,000	33,775,500	830,000	35,275,000	+ 7.2	— 4.3
Cleaners, vacuum (floor)	2,775,000	262,237,500	2,841,800	260,081,500	— 2.4	— .8
Dehumidifiers	98,000	13,715,100	87,450	12,505,350	+ 12.1	+ 9.7
Dishwashers	180,000	54,000,000	175,000	52,500,000	+ 2.9	+ 2.9
Disposers	353,000	45,890,000	260,000	33,800,000	+ 35.8	+ 35.8
Dryers (elec. & gas)	685,000	168,521,250	634,850	162,781,000	+ 7.9	+ 3.5
Fans						
Attic	101,000	15,150,000	95,000	14,250,000	+ 6.3	+ 6.3
Vent. & window	1,340,000	61,157,000	1,090,000	46,762,500	+ 22.9	+ 30.8
Freezers	1,200,000	480,000,000	1,140,000	421,800,000	+ 5.3	+ 13.8
Heaters, space (elec.)	1,380,000	36,235,250	1,202,000	31,203,000	+ 14.8	+ 16.1
Ironers	170,000	33,293,800	211,400	44,182,600	— 19.6	— 24.6
Radios						
Home	4,282,500	134,898,750	4,043,100	136,454,600	+ 5.9	— 1.1
Portable	1,795,500	62,591,100	1,719,900	59,336,500	+ 4.4	+ 5.5
Clock	2,301,000	78,234,000	1,929,000	65,586,000	+ 19.3	+ 19.3
Ranges	1,300,000	332,800,000	1,060,000	270,300,000	+ 22.6	+ 23.1
Refrigerators	3,775,000	1,113,625,000	3,570,000	1,017,450,000	+ 5.7	+ 9.5
Washers, electric	3,500,000	780,000,000	3,266,500	708,895,300	+ 7.1	+ 10.0
Water heaters, storage	862,000	113,784,000	720,000	95,040,000	+ 19.7	+ 19.7
Water systems	720,000	122,040,000	682,000	110,484,000	+ 5.6	+ 10.5
Television	7,000,000	1,995,000,000	6,096,000	1,719,072,000	+ 14.8	+ 16.1

How to Estimate Temporary Wiring

By John P. Reynolds

Today, electrical contractors are being asked to submit firm prices for temporary light and power work involved in building construction.

Increased labor rates have made this item a significant job expense. Since this has also occurred with many other particulars of construction which formerly were considered incidental costs, the architect is being forced to determine their value before contracts are awarded and work under way.

Electrical specifications are unusually vague on this subject. "Temporary light and power as required" is often the extent of work description. Until engineers and architects can be educated to specify exact requirements, the contractor is obliged to prepare his estimate on the basis of past experience. He must make a careful check of the general specifications and plans, then make a tentative layout of the temporary system, before starting the estimate.

Even the most accomplished estimator can not foresee all possible contingencies affecting temporary costs. If he did, he still could not include them in his bid or his price would be hopelessly out of line, thus arousing the architect's resentment and, conceivably, losing the entire contract.

The safer course, the more diplomatic course, is to bid on the basic apparent requirements and include in the bid a statement of work covered. In this manner, the price is explained to the architect and, more important, the contractor has some recourse if extra temporary work is thrust upon him during the job.

FIGURING the cost of temporary work is one of the most difficult jobs which face the electrical estimator. Although basic estimating technique is followed, considerable preliminary effort must be put into determining the extent of the work as there is seldom an adequate description of temporary requirements in the electrical specifications.

If he is on the job, the contractor can get a pretty good idea of basic requirements by consulting the builder's superintendent. When the temporary work is bid with the basic electrical job, however, the problem is even more difficult. It then remains for the estimator to analyze the job and make a tentative layout before he can begin to prepare his bid.

The Job Analysis

There are several factors which determine the amount of temporary light and power which will be needed.

A. *High ceiling areas*—In locations of this type where extensive finishing work is included, lighting will be costly. The estimator should determine whether or not scaffolding will be available to him. In warehouses and similar areas, high ceilings indicate lower costs because painting work will be delayed until the permanent circuit wiring is installed. Pigtail sockets will be wired to the outlets to preclude damage to fixtures. Floor level illumination can be provided from portable floods on conduit stands with weighted bases.

B. *Fenestration*—As with all lighting design, the amount of window space is a basic consideration in determining how much artificial illumination will be needed. In a glass walled office building, for example, temporary lighting may be limited to the elevator halls and stairs with only a token number of outlets in general office spaces.

C. *Concrete work*—Contractors are continually being plagued with the necessity of maintaining temporary light after working hours for concrete workers. Sometimes the builder will absorb this unforeseen expense, but not always.

There are two circumstances which indicate a strong possibility of overtime on this account. One is where specifications call for an integral cement finish on a slab poured on fill. The other case occurs on a job where dimensions of concrete arches are unusually large, so that the pour cannot be completed in a normal working day.

D. *Exterior*—There are two items under this heading which are affected by the physical layout of the building.

1. Sidewalk bridge lighting.
2. Shanties and outdoor workshops —does the plot plan suggest these locations will be at some distance from the building, thus necessitating overhead line work?

E. *Other trades*—Allowances must be made for furnishing power for pipe threading machines, terrazzo finishers and for higher levels of lighting for the plasterers.

Regular working hours of other trades should be noted to make sure they do not extend beyond those of electricians. If they do, overtime for maintaining temporary light and power must be included in the estimate.

F. *Completion date*—If adequate time is not allowed to finish the job, the general contractor may be forced to work overtime.

G. *Electric Service*—When the permanent utility service entrance and the switch and meter equipment cannot be used, allowance should be made for installing and removing a temporary installation.

H. *Other factors*—

1. General Contractor—one may demand considerably more light and power than another.
2. Climatic conditions.
3. Special equipment—spray booths, hoists, heaters, etc.

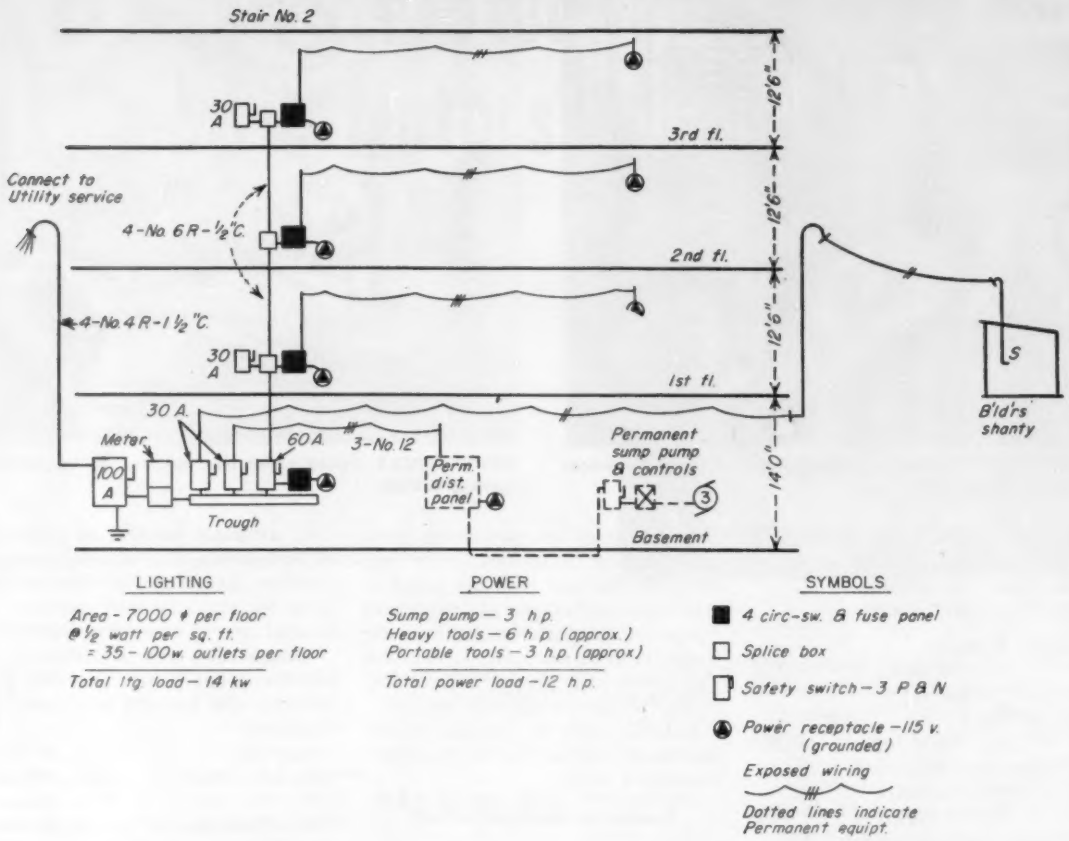
The Temporary Layout

For estimating purposes, the layout may be confined to calculating the lighting load, locating necessary power outlets and designating size and location of service equipment and risers. This will include any exterior work for shanties and a sidewalk bridge.

The lighting load may vary from ¼ to 1½ watts per sq. foot, depending on the factors mentioned in the discussion of job analysis.

Basic power requirements can be met by locating grounded receptacle outlets throughout the building so that no working area is more than 40 feet from a power source. Connecting portable tools to ungrounded lighting circuits is not only a code violation; it

TYPICAL TEMPORARY SYSTEM



is an extremely dangerous practice.

Heavier power loads for hoists, brick saws, sump pumps, etc. must be included in the temporary layout. Vertical risers must be installed in rigid conduit. A spare conduit for the permanent installation offers the best answer, even if it is necessary to enlarge its size to meet temporary requirements. If a spare is not available, the conduit is installed temporarily in a stairwell or any other convenient, continuous opening. Small switch and fuse type residence panels have been found well suited for use as local panels.

Throughout the temporary layout, maximum utilizations should be made of the permanent installation.

Preparing the Estimate

The form of an estimate on temporary light and power should follow this pattern with modifications to fit job requirements.

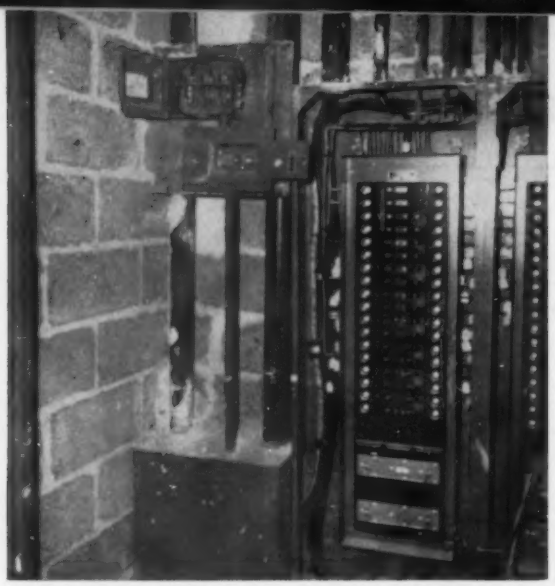
I. Service entrance—all work from Utility termination point to service switch.
II. Distribution.
  A. Main switch and meter equipment.
  B. Feeders.
  C. Main and local panels.
III. Lighting.
IV. Power Circuits.
V. Exterior work.
  A. Shanties and fabrication shops.
  B. Sidewalk bridge lighting.
  C. Floodlighting.
VI. Maintenance.
  A. Relocating and repairs.
  B. Overtime to maintain light for other trades.
  C. Cost of energy consumed.
VII. Removals.

The accompanying drawing represents a typical temporary wiring problem. In analyzing the architectural and electrical plans prior to laying out the temporary system shown, it was found that permanent service entrance and metering equipment could not be used. Cost of temporary standpipe, mains, switches, meter pan, trough and ground must therefore be estimated in the usual manner with one modification: items which can be reused on future temporary installations are charged at about 50% of cost. This percentage will vary according to the individual contractor's own experience and his attitude toward the advisability of salvaging materials, but the one-half write-off has been found a safe rule of thumb.

Since no spare conduits are available for the temporary riser, a separate conduit will be installed up stair well No. 2. Heavywall conduit is required. The labor rate for the 38 ft. run of 1¼ in. conduit is 11.0 hrs. per C., since three nipples must be cut and threaded.

Pull boxes on each floor facilitate tapping the feeder at panels and provide local power source for three phase motor switches, when needed. Regular labor units apply, but material costs again can be adjusted for salvage.

Temporary lighting is laid out to provide 35 100-watt outlets for each 7000 sq. ft. floor, or one lamp for each 200 sq. ft. of floor area. Distance between outlets will then be 14 feet.



SPARE CONDUIT RISER feeds temporary switch and residence type panel (upper left).

POWER TOOLS should never be connected to ungrounded lighting circuits.

Allowing for slack and waste, 2500 ft. of duplex wire will suffice. Labor for this item is as follows:

140-W.P. pigtail sockets (solder & tape) @ 14.0 m-hrs/c	—19.6
280—Porc. insulators (tie & hang) @ 10.0 m-hrs/c (note 12'6" ceiling ht.)	—28.0
2500 ft.—No. 14-2c wire @ 2.5 m-hrs/M	—5.3
4—Conduit stems at panels @ 0.5 m-hrs ea.	—2.0
12—Connect to panels @ 6 per m-hr.	—2.0
140—100 watt lamps @ 5.0 m-hrs/c	—7.0
Incidentals	—2.1
	66.0 man-hrs.

These units are based on application of production techniques. Splicing in pigtails, for example, should be done at floor level and preferably in lots of ten or more at a time. Wrapping split insulators can be accomplished more rapidly by doing them all in one lot. Conduit stems at panels—required to protect conduit to height of seven feet—can be scrap pieces of 1½ in. conduit and need not be mechanically connected to panel.

Power wiring is laid out to provide two 115-volt grounded connectors per floor. In addition, two 30 ampere, 3 P & N fused switches are included to satisfy needs of heavier construction equipment. These can, of course, be installed on any floor where they are needed. The contractor is expected to provide extension cords to permit local lighting and/or power in small enclosed areas.

Operation of the permanent sump pump must be maintained during construction. In line with the policy of maximum utilization of permanent equipment, the final installation of the feeder, controls and motor is used and only a temporary jumper to the cabinet of the distribution panel is required.

Exterior work, in this case, is limited to an overhead line to the superintendent's shanty.

Computing Maintenance Costs

The amount of time expended on repair and alteration of the temporary system is difficult to determine. The first step is to calculate the total number of weeks during which the system will be in operation. Discussion with the builder revealed when the first floor should be enclosed—an approximate starting point for maintenance of temporary light. Completion date was similarly determined and the operation period of the temporary system concluded to be about 30 weeks.

Since the average lighting level was relatively low, considerable relocation work was involved, particularly during the later stages of construction. The estimator, therefore, allowed two man-hours per week for each 10,000 sq. ft. of floor space, or a total of 5.6 man-hours per week. Replacement of lost or broken material was placed at $20.00.

It was known that the plasterers' working day extended half an hour beyond that of electricians. Checking with a plastering contractor who was bidding the job revealed this work would last four weeks. Overtime for maintaining light came to: 20 days @ ½ man-hr x 1½ (overtime) = 15 man-hrs.

In the same manner, an allowance of 10 man-hrs. was included to cover overtime necessary for maintaining light for masonry men working on finished cement flooring in basement.

Energy costs may be arrived at by calculating approximate monthly consumption and applying local rates. In this case:

Lighting	14 kw
Power—12 hp	9 kw
Total load	23 kw
Demand factor—40% Adjusted load	9.2 kw

Daily consumption—9.2 kw x 8 hrs. — 73.6 kw-hrs.

Monthly consumption—73.6 kw-hrs x 21 days — 1550 kw-hrs.

Removals

Removing the temporary equipment is almost entirely a manual labor item, not dependent upon the technical skill of the mechanics. Figuring average diligence on the part of the working force, removals would take 32 m-hrs. If extensive salvage of conduit, wire and wiring devices is contemplated, labor cost may increase by 50%.

The average temporary installation may not involve all the factors which have been considered here. Regardless of the extent of the work, however, estimating time will always be high in relation to the dollar volume of the job because of the necessity of analyzing the plans and laying out the system. But the time is well spent, for a well engineered temporary layout that makes maximum utilization of the permanent electrical equipment and eliminates unnecessary labor cost will decrease the total price of the contractor's bid substantially.

Coordinated Protection Of Electric Motors

An analysis of the function of each protective device in an electric motor branch circuit as required by the National Electric Code.

By L. D. Price *Manager*
*Engineering and Safety Regulations Dept., NEMA and A Panel of NEMA Experts**

U. L. REQUIREMENTS FOR MOTOR OVERCURRENT PROTECTIVE DEVICES

The Unit Must:

1. Ultimately trip at 100% of its rated current in an ambient temperature of 40 degrees C.
2. Trip within 8 minutes at 200% of its rated current.
3. Trip in 30 seconds at 600% of its rated current.

PROTECTION and safe control of electric motors and their circuits is an industry problem of considerable concern to electrical inspectors, contractors, maintenance men and equipment users as well as manufacturers of motors and control equipment. Safety is foremost among the many engineering factors entering into the proper installation of a motor and its controls. Adequate protective devices are available, but their successful performance is dependent upon proper selection, installation and maintenance. Hence the following discussion will analyze the function and contribution of each protective device in a "coordinated" motor branch circuit such as indicated in the diagram in Chapter 10 of the National Electrical Code. This includes the motor, motor controller, motor running overcurrent device, motor branch circuit conductors, disconnecting means and motor branch circuit overcurrent protection.

The term "coordinated" as applied to the branch circuit merely means that all elements contained therein shall work together in a safe manner under any condition of operation from normal running condition right through locked rotor and up to and including a short circuit or ground condition.

*Panel Members

R. H. SMITH, Motor and Generator Section
V. G. VAUGHAN, Automatic Temperature Controls Section
J. J. MELLON, Indusrtial Controls Section
J. C. INGRAM, Fuse Section
H. I. STANBACK, Molded Case Circuit Breaker Section
Panel discussion presented at the I.A.E.I. Silver Jubilee Convention, Chicago.

Why Motors Need Protection

By R. H. Smith

The electric motor, not being 100% efficient, dissipates part of the energy drawn from the power lines as so-called "losses" which show up as heat. Designers strive to keep these losses to a minimum, and provide for the transfer of heat away from the motor to avoid creation of temperatures in excess of the heat-resisting abilities of the materials of which the motor is built.

Modern motor design results in better heat transfer through the use of denser insulating materials. Newly developed synthetic materials are supplementing, and in some cases replacing, cotton, paper and natural resins to increase heat transfer while withstanding higher temperatures before deteriorating. Good practice, economy in use of materials and the need for space conservation dictate that certain limitations be considered in recognizing normal application practice and use. Motors operated within those limitations are expected to give years of uninterrupted service and offer no hazard to the surroundings.

Motors differ from heating and lighting equipment in that the current and power which they draw from the line are not fixed, but vary with operating conditions. In general, a motor will attempt to drive any load encountered and will draw more and more power from the line as a consequence.

Most motor applications allow either intentional or accidental overloads which may be continuous or intermittent. If subjected to conditions beyond the assumed motor design limitations, the current drawn from the line may be excessive, mechanical parts may be overloaded and operating performance affected. Burned-out motors may result from suddenly developed excessive temperatures, or gradual deterioration of material from extended overloads. Consequently, safeguards are necessary.

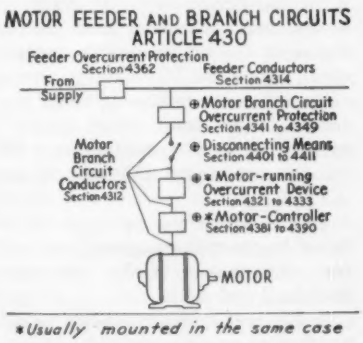


FIG. 1—N.E.C. Diagram of motor branch circuit showing control and overcurrent protection components together with Code sections relating to same.

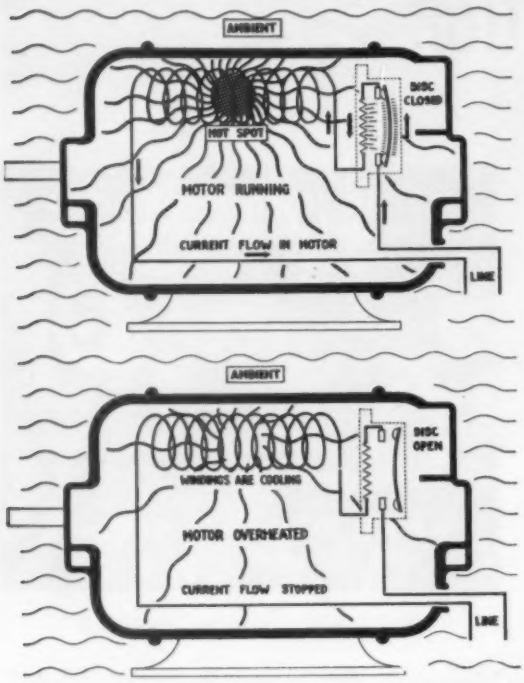


FIG. 2—Thermal protector built in motor is in series with the motor winding. Contacts on thermostatic disc remain closed (top) during normal motor operation; open when motor is overheated (bottom).

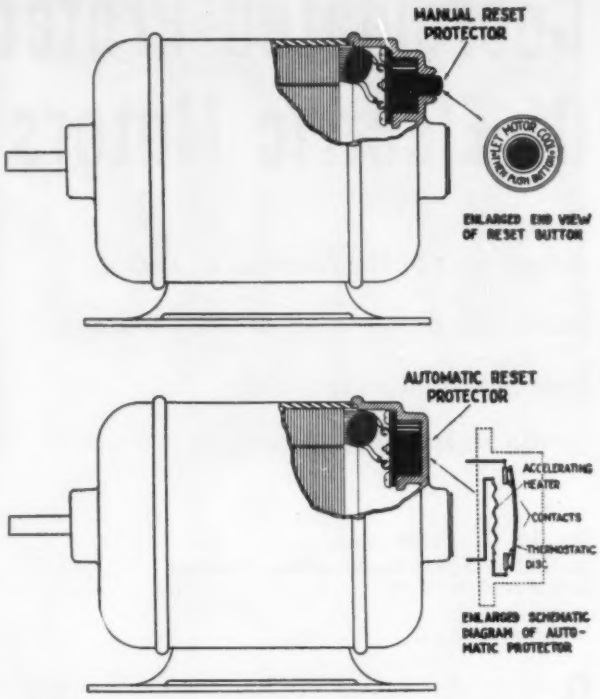


FIG. 3—Inherent overheating protectors built in motors can be of the manual reset type (top) or automatic type (bottom). Overheated motor must cool before contacts are reset. Protector limits winding to fixed maximum temperature.

Inherent Overheating Motor Protection

By V. G. Vaughan

The first device in the "coordinated" protection group is the inherent overheating motor protector—a protective device integral with the motor which is responsive to motor current or to both motor current and temperature. It is a thermal device built into the motor to disconnect the motor from the line *before it reaches an unsafe temperature* (Figs. 2 and 3).

An inherent overheating motor protector differs from other types of motor overload protection in that (Code paragraphs 4322.a.2, .b, and .c.2):

1. The proper rating must be selected by the motor engineer and built into the motor (Code paragraphs 4322.2.a.2 and .c.2).

2. The unit is approved with the motor that it protects.

3. If the motor is installed in excessively hot locations the inherent protector may take the motor off the line at less than full load, as the device limits the motor winding to a fixed maximum temperature for any source of heating.

In a properly coordinated motor circuit, the motor overheating protector protects the motor, controller and circuit up to the minimum amount of current required to trip the branch circuit overcurrent protector. For currents in excess of this, circuit protection is the responsibility of the branch circuit overcurrent protector (Code paragraphs 4341, 4342, 4343).

The inherent protector is at the motor end of the circuit and is not intended to protect against grounds or short circuits in the line or in the motor windings.

To protect the operator against shock due to grounds in the winding, the motor frame should be properly grounded or isolated so that the operator cannot come in contact with the motor frame.

A number of surveys in fractional horsepower motor repair shops indicate that inherent protectors reduced motor burnouts by at least 80% as compared with motors improperly protected. A few inherently protected motors do burn out because of (1) lightning; (2) grounded and shorted windings due, in most cases, to wet locations; (3) incorrect connections; and (4) improper protector application.

The greatest problem at present is to educate motor users—particularly field installation and service men—on what an inherent protector will and will not do, how it operates, and not to tamper with the protector. Much of the present experience is confined to fractional horsepower, single-phase motors, but increased usage in integral and polyphase motors is expected in time.

The inherent protector's sole function is to prevent motor fires due to overheated motors. It is not designed to protect circuits from currents in excess of locked rotor resulting from grounds, short circuits or human errors.

Motor Controllers

By J. J. Mellon

The next step (following the Code diagram) is the motor controller—required primarily for starting, stopping, reversing, accelerating and decelerating motors. Some of these units are equipped with devices to provide motor running overcurrent protection.

Motor controllers are made in two basic types: manually and magnetically operated. In the former, the contacts are opened and closed by mechanical action. In the latter, contacts are operated by energizing or de-energizing a magnet coil which can be operated either by pushbutton or other pilot device. Both types are usually provided with thermal overload relays in the same enclosure.

Magnetic motor controllers generally have an additional feature called "low-voltage protection" which contributes to personnel safety as well as equipment protection beyond basic Code requirements. The low-voltage feature prevents the motor from restarting (after stopping from loss of voltage) on return of voltage until the machine operator again actually operates the pilot device.

The simplified illustration (Fig. 4) shows how the low voltage feature is obtained with a magnetic across-the-line starter. If the pilot device in the two-wire control diagram on the left is closed, the motor will start and stop without any warning on failure and return of power. This type of control should never be used where unexpected restarting of a motor can be a hazard to operator or machine.

To operate the starter in the three-wire control diagram on the right, the start pushbutton is momentarily depressed and the switch closes. When the finger is removed, the starter will not drop out because as the switch closed, an auxiliary contact closed the contact between 2 and 3 and thus short-circuited the momentarily operated start contacts of the pushbutton station. When power fails, the switch opens and contact between 2 and 3 also opens. When power returns, there is nothing to reclose the switch unless the operator again pushes the start button.

Many accessories or modifications are available in controllers (reverse phase relays, phase failure relays, field loss relays, additional electrical or mechanical interlocks, etc.) to provide additional personnel or machine protection. The principal factor of suitability, as far as the Code is concerned, is that the controller start and stop the motor and *have an interrupting capacity at least equal to the stalled rotor current of the motor.* With few exceptions, the controller must have a horsepower rating not less than that of the motor which it controls.

Motor Running Overcurrent Protection (included in many motor controllers) is required to protect the motor, motor control apparatus and branch circuit conductors against excessive heating due to motor overload currents. The Code provides for the coordination of motor running overcurrent protection and motor branch circuit overcurrent protection. Both function to protect the branch circuit conductors, motor control apparatus and motor. Each, however, has its own protective mission.

The motor branch circuit overcurrent protective device is designed to protect against overcurrent due to short circuits and grounds. The motor running overcurrent protective device is designed to protect against motor overload currents. Any short circuit protection received from the motor running overcurrent protective device or any motor overload protection received from a motor branch circuit overcurrent protective device should be regarded as strictly coincidental and can hardly be counted upon to provide the completely safe installation.

Well designed motor running overcurrent protective devices must also permit normal starting of the motor and full utilization of the motor capacity. If the overload device removes the motor from the line while operating below rated capacity, the operator will be tempted to short out the relay. To avoid this, the overload device must be carefully designed, taking into account the motor characteristics, and applied so that a 40-degree C. rise motor will be taken off the line when running continuously between 115% and 125% of full load current. To do this, motor running overcurrent protective devices are necessarily responsive to both the horsepower output of the motor and the electrical

Some Causes of Motor Overload Current and Excessive Heating

1. Prolonged overloading due to excessive operating overloads or low line voltage.
2. Too frequent starting of equipment not rated for jogging service, or too frequent operation of equipment with intermittent duty rating.
3. Excessive mechanical load resulting in failure of the motor to start, or the stalling of the motor.
4. Single-phase operation of a polyphase motor resulting from an open circuit on the secondary side of a distribution transformer.
5. Single-phase operation of a polyphase motor resulting from an open circuit on the primary side of a distribution transformer when used with a wye-delta or delta-wye connection.
6. Unbalanced 3-phase voltage.

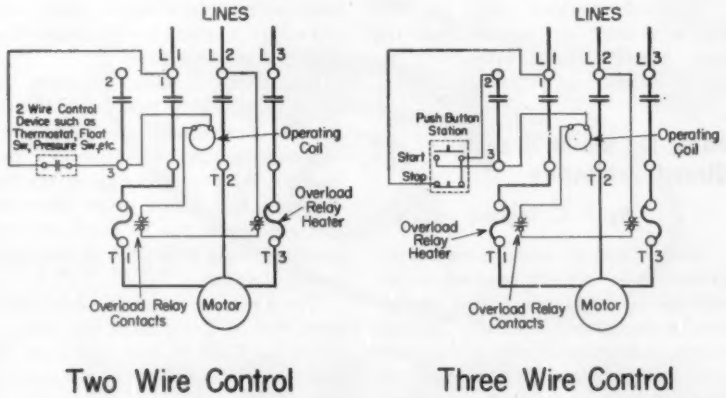


FIG. 4—Low-voltage protection on a magnetic across-the-line starter. Motor with two-wire control (left) will start and stop without warning on loss and return of power. With three-wire control (right) operator must push start button, after power failure, to close contact between joints 2 and 3 before line contacts will reclose.

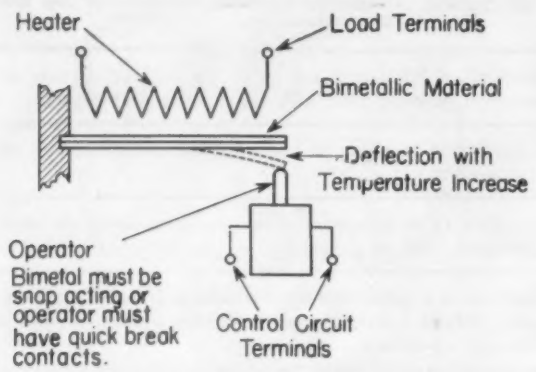


FIG. 5—Bimetal type relay for overload protection has bimetallic strip which deflects to open relay contacts and trip controller when excessive overload temperatures develop in the motor circuit.

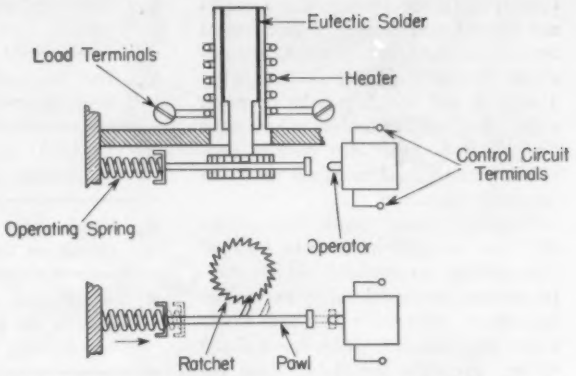


FIG. 6—Solder pot relay uses film of eutectic solder around ratchet shaft. Heating from overload current liquifies solder film and spring-actuated pawl (restrained by ratchet) is released to open control circuit.

input; and must take into account the thermal capacity of the motor and the effect of the operating duty cycle.

Certain special motors require overcurrent protective devices having extremely special characteristics. Hermetically sealed compressor motors are typical examples. Applications requiring either long accelerating time or unusually quick tripping have resulted in special thermal overload relay designs with characteristics to fit specific applications.

While the inherent protector is mounted on the motor, thermal overload relays are generally mounted in the controller enclosure. This practice, however, is not obligatory under the Code.

Thermal Overload Relays and How They Work—Thermal overload relays make use of the heat-storing ability of a thermal responsive element and its connected heat-absorbing mass. Heat generated by the motor load current flowing through the relay heater element is conducted, or radiated, to a heat sensitive element which causes the relay contact to open when the thermal element has reached a selected temperature.

In a typical overload relay of the bimetal type (see Fig. 5), motor current flows through the heater element (a coil or strip resistor). If the current is excessive, the heat generated deflects the bimetal element opening the relay contacts and tripping the controller. Because bimetal strip deflection is often relatively slow, overload relay contacts must be of the quick-break type.

Other overload relay designs of the solderpot type use a eutectic solder film which melts at a certain temperature caused by overload current flowing through its heater. Since the heater (see Fig. 6) is connected in series with the motor, excessive current will melt the eutectic solder film. Then, the operating spring through the pawl can turn the ratchet and open the control circuit. A eutectic solder is a metal alloy that changes from a solid to a liquid at a certain definite temperature without going through the "mushy" stage. Its melting point can be predicted accurately.

Relays of either type can be used to protect motors of various sizes by merely changing the heater elements. Such relays are designed to reproduce within themselves, in a miniature fashion, the heating that is going on in the motor winding.

Magnetic overload relays of either the time-limit or instantaneous-trip type are also used extensively for motor overcurrent protection.

Fuses for Motor Branch Circuit Protection

By J. C. Ingram

Motor branch circuit overcurrent protective devices are required to protect the motor branch circuit conductors, motor control apparatus, and the motor from *overcurrents due to short circuits or grounds.* Two types provide this protection—fuses and circuit breakers.

The function of a fuse in the motor circuit is to provide short circuit protection to the circuit and its component parts. Whether the short develops in the circuit wiring, motor, or starter, the fuse is depended upon to clear the circuit promptly and confine damage to the point of origin of the short.

Three types of fuses are available today. All are tested and listed by Underwriters' Laboratories under the same fuse standard (receive identical tests).

The first and oldest type is the one-time (non-renewable) fuse.

The second type is the renewable fuse. It has longer time delay than the one-time unit because the mass of metal in the fuse link is increased. This is done by changing the shape of the link or welding lag plates to it. The rate of heating is thus retarded so that under overload it takes longer to raise the temperature of the link to its melting point. This effect is particularly desirable at low overloads. Renewable fuses with increased time delay actually clear a short circuit faster than ordinary one-time fuses.

Dual-element fuses comprise the third type. This fuse consists of a thermal element with a fast-acting fuse link combined in a standard NEC fuse casing. By proper design of the two elements, fast action under short-circuit conditions can be combined with extremely long time-delay at the useful overload values.

The maximum allowable fuse rating permitted by Table 20 of the National Electrical Code is such that even the fastest operating fuse will not open on normal motor starting currents. In other words, if the fuse ratings are selected from Table 20, all three types will carry the motor starting surges without opening.

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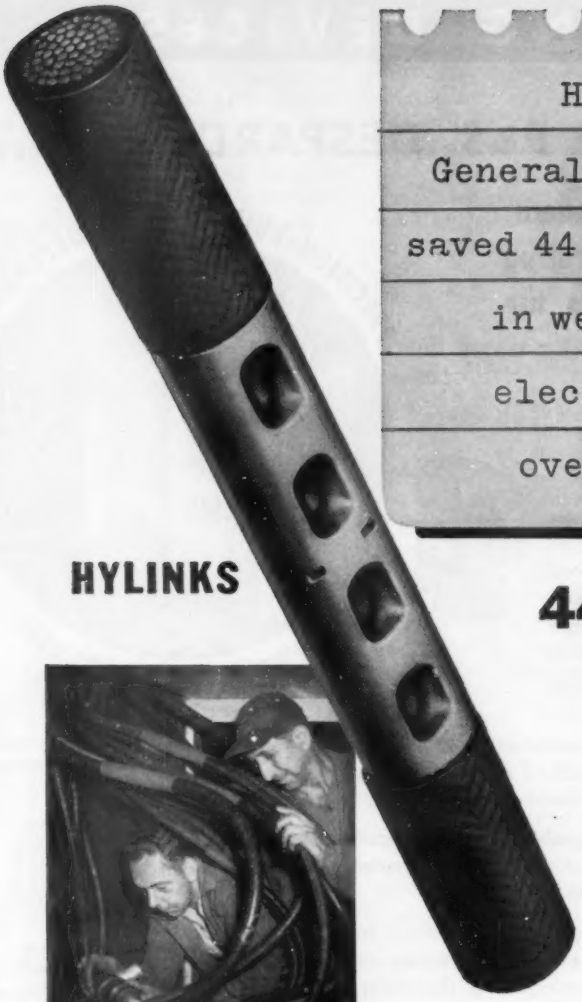

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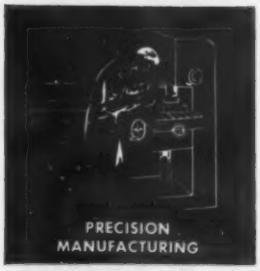
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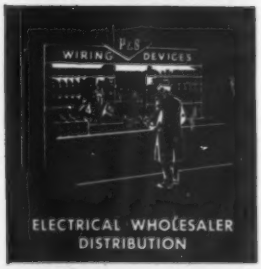

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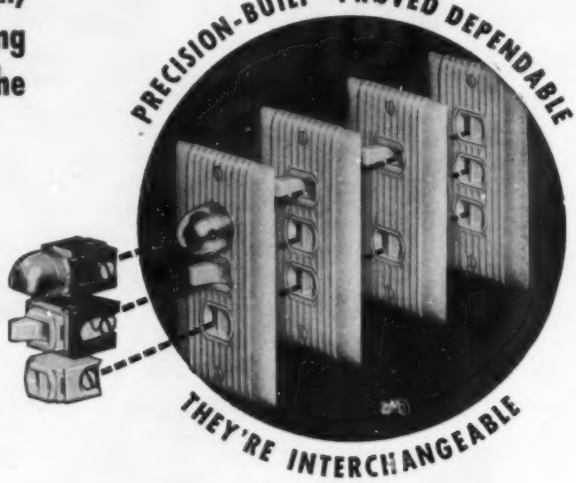

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Type and rating of fuses most suitable for an installation are determined by the type of protection needed for the circuits and their component parts. If renewable fuses are selected, a rating smaller than the maximum allowable can be used because of their increased time delay. This, in turn, may permit smaller disconnect switches. Also, the smaller fuse rating can result in speedier clearing of the circuit when faults occur—hence added safety.

If dual-element fuses are selected, their rating can be much closer to the actual motor rating because of their greater time-delay feature. Reduction in switch size and faster short-circuit performance result.

To illustrate this point, assume that a 208-volt motor draws 300 amperes for 12 seconds during starting (see Fig. 7). With one-time fuses, a 110-ampere rating must be used in 200-ampere fuse clips.

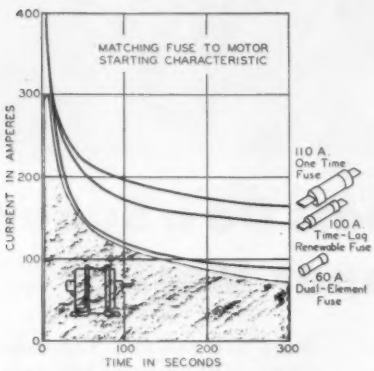

FIG. 7—Motor circuit fuses should be matched to motor starting characteristics. Fuses with greater time-delay features in their design can be used in smaller sizes to protect motor circuits and still hold under starting surges. Result: smaller disconnect switches and speedier clearing of circuit under fault currents.

If renewable, time-delay fuses are selected, a 100-ampere rating can be used without reducing the starting capacity of the motor. These require the next smaller size of fuse clips (100 ampere).

With dual-element fuses, a 60-ampere rating can be used which will still hold 300 amperes for 12 seconds. The use of a smaller size switch is obvious.

When dual-element fuses of proper rating are installed in disconnect switches, they take care of the blind spot in a controller with two overload relays when single-phase conditions occur on a primary of a wye-delta or delta-wye connected system. When the excess current of single phasing is flowing through the unprotected conductor in the starter, the dual-element fuses in all three conductors will clear the circuit.

Motors of 1 hp or less, manually started, are not required by the Code (section 4322.b) to have individual overcurrent protection. Dual-element fuses of proper rating will provide dependable overcurrent as well as short-circuit protection for these applications.

Circuit Breakers For Branch Circuit Protection

By H. I. Stanback

Each motor branch circuit (note Chapter 10, NEC, diagram for Article 430) must be provided with a disconnecting means as well as overcurrent protection. The circuit breaker is a single device which does both jobs safely. That dual function is accomplished by a mechanism which can be manually operated or which (through a "trip-free" feature) will automatically open the contacts when fault currents, due to shorts or grounds, occur—even if the breaker handle is held in the "on" position. This automatic trip member is sealed to prevent tampering with its calibration or otherwise interfering with its normal operation. Circuit breakers provide the necessary interrupting capacity and speed of tripping to safely clear the circuit of fault currents in excess of stalled rotor conditions. Damage is thereby limited to the place where the original short or ground occurred.

Why are circuit breakers not rated in horsepower? The answer to this frequently asked question is rather obvious when you consider horsepower rating as applied to other disconnect devices. It is intended to indicate the safe interrupting capacity of the mechanism under conditions of overload. On the other hand, a circuit breaker is designed to interrupt fault currents on the order of from 5,000 to 10,000 amperes, depending upon the breaker rating. In addition, overload tests at six times breaker ratings are made. These are 1½ to 2½ times higher than stalled rotor currents of motors with which the breakers are used. Thus, a horsepower rating corresponding to the actual interrupting capability of a circuit breaker mechanism would be many times greater than any rating considered practical when other application factors are considered.

Selection of the maximum rating of circuit breakers which may be safely used for each installation is relatively simple. Generally, *the allowable circuit breaker rating is 1½ to 2½ times the motor nameplate current rating.* Tables 26 and 27 in Chapter 10, NEC, indicate (in the last column) the permissible ratios expressed in percentage.

Many installations have breakers smaller than the maximum rating permitted. Such selection was based on experience with motors on previous jobs involving similar starting duty requirements. As long as the breaker is large enough to hold in when the motor is started, it is satisfactory, and even desirable, to use the smaller rating. The reduced rating results in faster automatic opening of the circuit under fault conditions and gives added protection.

Circuit breakers are especially well suited to polyphase motor circuits, since all poles are simultaneously opened on either manual or automatic operation. Should a fault occur on one phase, all hot lines are immediately disconnected and single-phasing of the motor is prevented.

Motor Branch Conductors And Disconnects

By L. D. Price

Motor branch conductors exist solely to carry electrical energy to the motor. Once motor size has been determined, selection of proper conductor size is relatively simple. Table 20, Chapter 10, NEC, lists conductor sizes for motors of various horsepower ratings: provides for 115% to 125% full-load current operation of 40 degree C. motors.

A disconnecting means is required to provide protection to personnel only. Some provision must be made to isolate the circuit while servicing the motor, controller and any branch circuit conductor on the load side of the disconnect. With few minor exceptions, the Code requires that this disconnect be a motor circuit switch (rated in horsepower) or a circuit breaker. This is required in order that the device have enough interrupting capacity to open the circuit in case of a stalled motor. The Code also requires a current-carrying capacity of at least 115% of the nameplate current rating of the motor. For maximum safety personnel the disconnecting means should be readily accessible and should plainly indicate whether it is in the open or closed position. The disconnecting means may be incorporated in the same enclosure as the controller.

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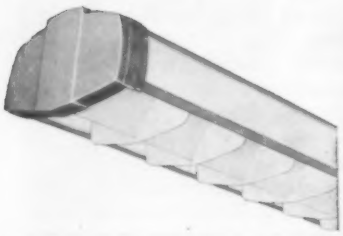

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Bakery shadow boxes, large, 175 ft-C.

Vegetable counters, 200 ft-C.

Displays at ends of regular goods shelves on cross aisles, 300 ft-C on high levels; 400 ft-C 7 feet from the floor.

Dairy goods, cheese, etc., upper level, 250 ft-C; lower level, 400 ft-C.

Ice Cream section, 300 ft-C.

Frozen meat, fish, etc., 100 ft-C.

Meat cutters, 200 ft-C.

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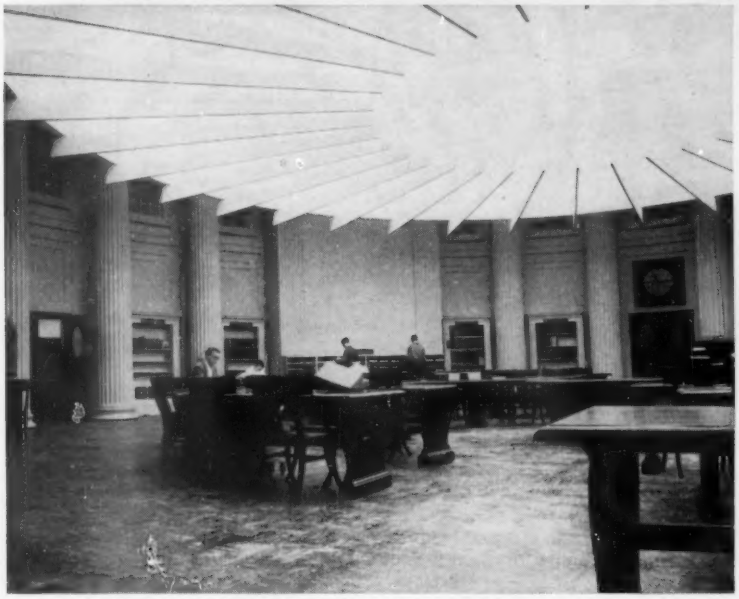

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The Engineering Library, which occupies a circular space below the huge dome of Central Library, Massachusetts Institute of Technology, Boston, is lighted by a single suspended lighting unit. Measuring over 50 feet in diameter and weighing 16 tons, this unit is believed to be the largest single suspended lighting unit ever installed.

The lighting in this area was previously poor, even though a total of 30,000 watts of floodlighting was installed above the circular skylight at the eye of the domed ceiling. Also, the acoustics were poor. Among the many ideas proposed for improving the lighting was a suggestion that all dome surfaces be painted with a high reflectance paint. This idea was discarded because of the expensive scaffolding which would be required for frequent painting.

The solution finally adopted was proposed by MIT Professors L. B. Andersen and H. L. Beckwith, and included five objectives: 1) to keep the dome, which to many symbolizes the Institute externally, clearly defined as a dome for those inside the building; 2) to avoid any lighting method which would require frequent painting of the dome, because of the great amount of expensive scaffolding and materials needed; 3) to maintain a satisfactory level of illumination at table top reading levels; 4) to substantially reduce noise reverberation in the room; and 5) to reduce the size of the original space to a smaller scale, one more friendly and less distracting.

To meet these objectives, a gigantic luminous indirect "chandeluminaire" using fluorescent lamps was suspended from the domed ceiling so that the bottom of the unit is 14 feet 2 inches above the floor. It also includes 28 light, hollow, acoustical metal baffles each 16 feet long and perforated for sound absorption by materials within, installed radially around the outer edge of the huge circular luminous ceiling.

LARGEST LUMINAIRE ever installed is luminous-indirect unit, over 50 feet in diameter, weighing 16 tons, which is suspended from original dome ceiling in Central Library, Massachusetts Institute of Technology, Boston.

The lighting load totals about 14 kilowatts, and consists of 92 72T12 and 144 48T12 fluorescent lamps installed above the diffusing panels. Less power is required for the giant unit, including the floodlights left in the dome after remodeling, than was required originally. This new "chandeluminaire", as it has been dubbed, delivers 75 footcandles at desk surfaces after three months in service. There is now considerable contrast between the luminaire bottom surface and the dark floor and furniture. The lighting installation, however, is considered the first step in a renovation which will replace the dark floor and furniture with lighter shades, to bring brightness comparisons throughout the area much closer together.

Suspension of this giant lighting unit is by four 2⅜-in. outside diameter seamless steel tubes, hung from a framework of steel attached to the structural concrete dome at 12 points. The tubes provide the wire raceway to the luminaire body which hangs 51 feet below the dome skylight.

Diffusers, T bars and hangers were supplied by the F. W. Wakefield Brass Co., Vermilion, Ohio, the lighting equipment manufacturer which cooperated with authorities at MIT in the development of the all-luminous Wakefield Ceiling. The diffusers are of corrugated Plexiglas of the same specifications of translucence and thickness (.82") used in the standard Wakefield Ceiling.

Integrated Ceiling For Light, Sound, Air

The engineering drafting room in Stimpsonite Plastic's Chicago office has a corrugated plastic back-lighted ceiling which, after two years and one washing, delivers 60 footcandles of diffuse, even illumination to desks and drawing boards in this critical-seeing area. Since the luminous panels are supported by acoustical baffles, and since circular air conditioning units pierce the suspended ceiling in several locations, the ceiling becomes an integrated surface that provides the office with high quality lighting, sound absorbing characteristics and an ample supply of tempered air.

Above the 15-foot-high ceiling are

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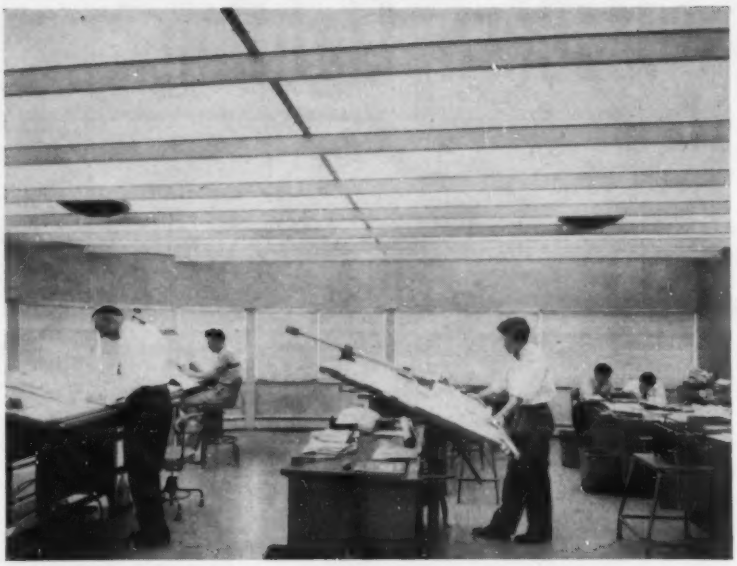
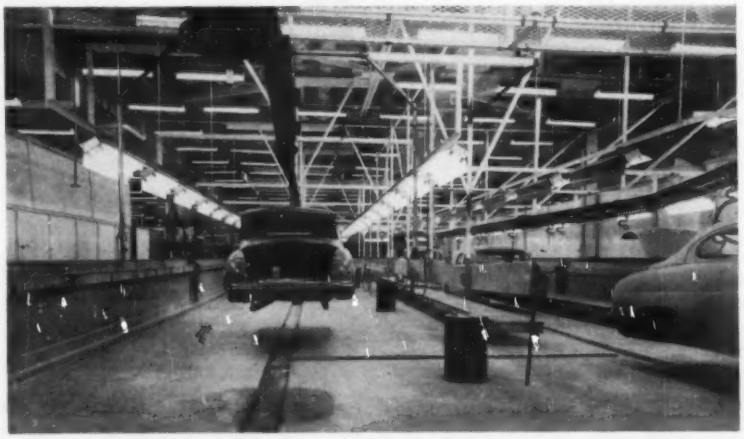


60 FOOTCANDLES of glareless illumination are delivered to drafting tables by corrugated plastic ceiling back-lighted by fluorescent lamps mounted in continuous rows on 2-foot centers.

99 cool white fluorescent lamps, mounted in continuous rows on 2-foot centers. Lamps are T12s; 95 being F40s and 4 being F20s. Maintaining reflectances at a high level are the light grey walls and the linoleum flooring consisting of mottled tan and grey tiles.

Angled Fixtures Kick Light Output Inward

Assembly lines and inspection lanes in automotive plants demand concentrations of light along the paths travelled by chassis and car bodies moving via conveyor from one working position to another. In the Lincoln-Mercury plant, Linden, N. J., this concentration is obtained by flanking each lane with 2-lamp industrial fluorescent fixtures closely spaced and tilted at a 45-degree angle to direct light inward toward the center-line area where seeability is most important. These angled fixtures augment the general lighting installation which utilizes the same type of luminaire, mounted at the truss level. The combination of the two systems results in an overall illumination level of 30-fc, with average values of 85-fc obtained on the sides of the moving vehicles. The low mounting height makes maintenance of the relatively high illumination a simple matter.



CONVEYOR-CARRIED CARS in Lincoln-Mercury assembly plant are illuminated by flanking rows of 2-lamp industrial units mounted on 45-degree angle to direct light inward. General illumination is also provided by uniform pattern of fixtures mounted on messenger cables strung from truss to truss in the entire area.

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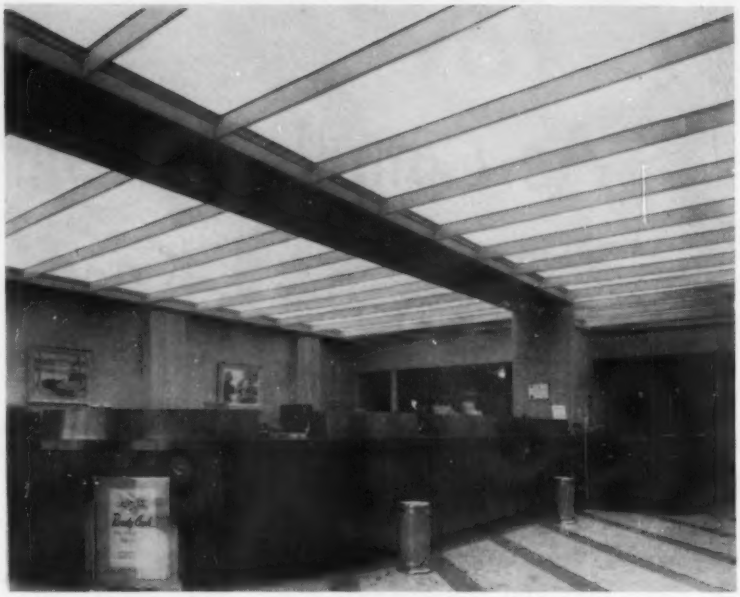

LUMINOUS CEILING in general banking area of Union Savings & Loan Bank, South Euclid, Cleveland.

Dual-Purpose Ceiling Modernizes Bank

A new Acusti-Luminus ceiling installed throughout the general banking area of the Union Savings and Loan Bank, in South Euclid, Cleveland, Ohio, performs a dual function. It not only provides a high level of well diffused glareless illumination for depositors and personnel alike, but also provides acoustical correction, contributing to a quieter and more pleasant atmosphere. Installation of this new luminous ceiling effectively modernizes the complete interior, and does it at a minimum cost.

The new ceiling is basically a lighting system. It consists of translucent corrugated Lumi-Plastic diffusers supported in a series of metal tracks suspended below the normal room ceiling, on which are also mounted continuous rows of fluorescent lamps on standard wireway channels. Light from the bare lamps passes through the plastic diffusing panels into the room below, and is so completely diffused in doing so that virtually no shadows result. The diffusers also conceal the lamps completely, and spread the lamp brightness out over their entire area so that eye-fatiguing glare is practically eliminated. An intensity of 50 footcandles of high quality comfortable illumination results.

Acoustical baffles attached to the bottom of the diffuser-panel track-supports provide acoustical correction. These baffles are U-shaped, perforated, steel jackets packed with dense Fiberglas, which absorbs noise. These baffles, which appear to be narrow beams are spaced on three foot centers and absorb about 40% of the noise created by office machines and general traffic.

The original high ceiling in the banking interior supports air conditioning ducts, beams, and sprinkler heads. These are all concealed by the new luminous ceiling, yet are readily accessible since the plastic diffusers can be rolled back on their supporting tracks with ease. A similar procedure is followed for replacing burned out lamps. The plastic diffuser panels are completely removed for cleaning, which may be done by washing and use of a mild detergent. Sprinkler heads were left undisturbed on the original high ceiling, since the vinyl plastic diffusers soften sufficiently at 145° F. to permit them to drop from their supports, and the sprinklers are set (normally) to operate at 165° F. The arrangement has approval of the Underwriters Laboratories.

By installing a luminous ceiling type of lighting system in this area, the Union Savings & Loan Bank effected considerable savings and still accomplished the desired modernization. Had the conventional solution been adopted, the modernization would have involved a "hung" ceiling, sprinklers would have had to be lowered and framed in the new "hung" ceiling. Also, an alternative lighting system, complete with materials, equipment and labor would have had to be added. This approach would have been far more expensive and the lighting result in all probability less satisfactory.

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Ask us to send you our 8-page Smithcraft Director. The folder contains the results of comparative tests conducted by one of the nation's outstanding utilities . . . a leader in lighting.

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General Electric's new CF-7 portable hook-on recorder (volt-ammeter) gives you the first convenient means of recording current without having to cut conductors or interrupt service. Or, by simply attaching leads—you can get voltage records over a wide range.

FAST HOOK-ON INSTALLATION

Simply connect the recorder to a suitable power supply for the chart drive. Then select the proper range and hook on for up to 30 days record of current.

INSULATED TO 8.7 KV

The butyl-molded transformer carries an ASA insulation rating of 8700 volts. Other safety features include:

- Safety-lead connectors, which short circuit transformer when disconnected;
- Safety-latch on hook locks in closed position.

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Consisting of a hook-on current transformer, connecting lead, and inkless recorder, this new instrument offers you:

- Inkless recording for minimum servicing, clean records;
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- Seven ranges—15/75/150/750 amperes, 150/300/750 volts;
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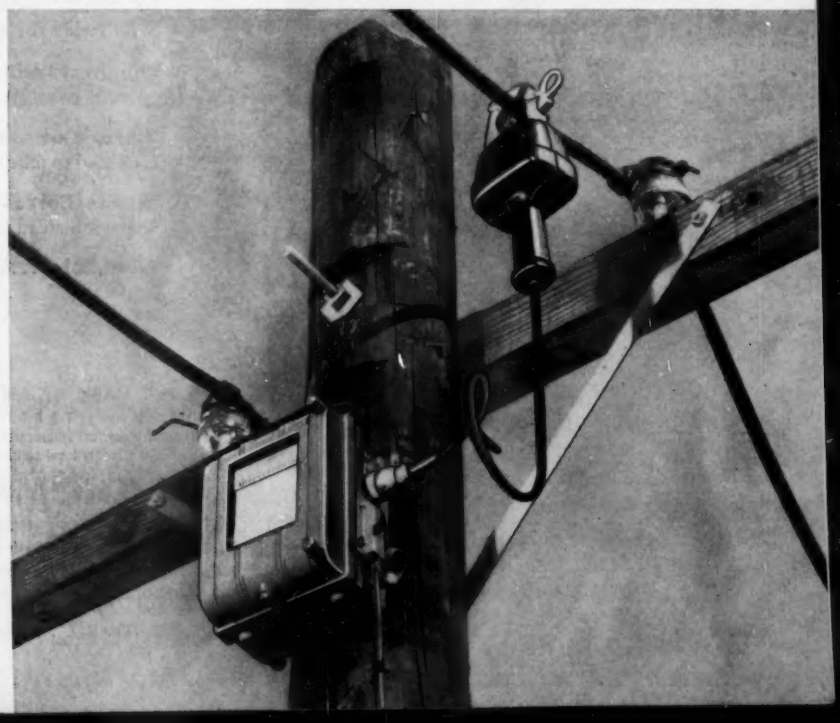
- 120/240 volt chart drive.

For further information, contact your nearest Apparatus Sales representative or write for bulletin GEC-1225 to Section 602-267, General Electric Company, Schenectady, N. Y.

SELF-SUSPENSION of the current transformer is made possible by a spring latch. Self-locking simplifies installation in such applications as checking of line loads.



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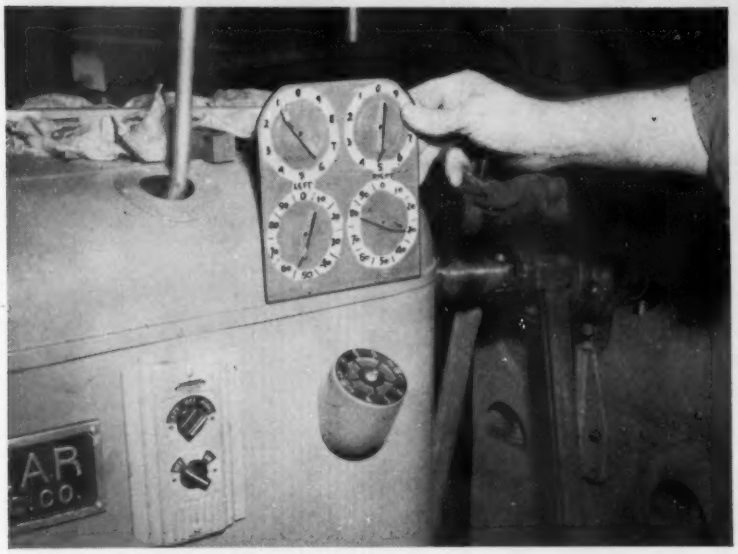


Memory Dial Added To Dynamic Balancer

Mechanics at the Evansville Electric & Manufacturing Company, Evansville, Ind., motor repair department are taking no chances of making mistakes, especially when dynamically balancing armatures and rotors. Improper balancing can lead to a lot of grief when the motor is assembled and placed in operation.

Unlike static balancing, which is concerned with only one set of unbalance figures, dynamic balancing involves two sets of figures, one for each end of the rotating shaft (each bearing). This means the mechanic operating the dynamic balancing machine has more figures to remember, more chance to become confused, more chance to forget what he read on the indicating dial.

To forestall such developments at E.E.&M. mechanics added a memory dial to a 3,000-pound, 60-inch swing, dynamic balancing machine. It is a simple piece of sheet metal on which four dials are painted. Each dial has a metal pointer which can be set by hand. The two top dials (see photo) duplicate the numbers on the machine dial which indicates position of unbalance on the armature. The left dial is for the left end of the rotor, the right dial for the right end. The two bottom dials are for manual indication of the amount of unbalance (distance bearing support moves toward operator due to unbalance). Numbers on these dials indicate deviation off-center.

When a mechanic balances the left side of a rotor he notes the machine dial indication for position of unbalance and sets the pointer to the corresponding number on the upper left hand memory dial. He then sets the pointer on the lower left hand dial to indicate amount of unbalance. When he switches to the right side of the rotor, he repeats the cycle using the upper and lower right hand dials. It is as simple as that.

Portable Agitator For Varnish Tank

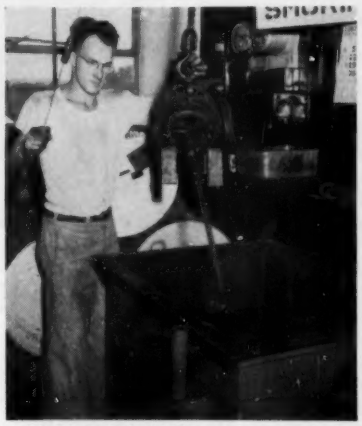
It looks like an outboard motor, but it's actually an oversize electric mixer.

That is R. A. Bonham's description of a portable agitator he built at Phoenix Electric Company in Mansfield, Ohio, to use on their 50-gallon varnish dip tank.

To be thoroughly effective as an insulating medium, varnish must be of a homogeneous composition and free of air bubbles. Such aeration usually takes place when more varnish is poured into the dip tank or when thinner is added to the mixture. That's why varnish must be stirred when either of the above operations take place, like mixing paint when a color pigment is added.

Stirring can be done by hand with a paddle, but agitation must be gentle. Additional air can be introduced by a rough, sloshing action. And frequently hand agitation means a two-man job, one man stirring and one man adding the varnish or thinner. Bonham's portable electric agitator makes this a one-man chore and minimizes air bubble suspension in the varnish mixture.

The unit consists of a one horsepower, 220-volt, 3-phase, 3600 rpm, motor with an impeller blade at the end of a 33-inch long, $\frac{3}{8}$-in. diameter brass rod shaft. Two mounting brackets of 2-in. by $\frac{3}{8}$-in. steel stock slip over the side of the square tank and tilt motor and shaft at about 30° to the horizontal.



ELECTRIC AGITATOR with long impeller shaft is being lowered into position on varnish dip tank by electric hoist. Unit is used when varnish or thinner is added to tank.

STURDY BRACKETS slip over side of tank and tilt motor and shaft at about 30° angle. Spacer block fits under angle-iron overhang of tank rim; steadies motor when in operation.

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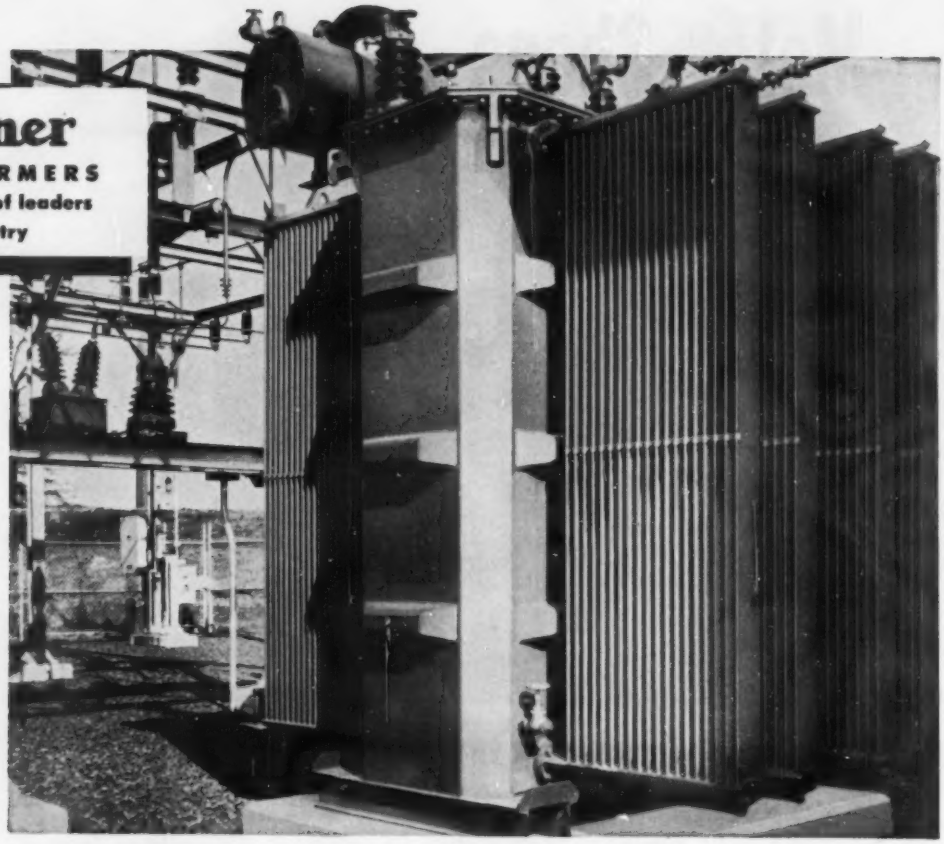

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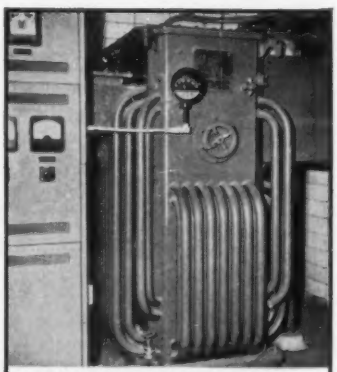
A Wagner engineer can help you select the right transformers for *your* requirements. Consult the nearest of our 32 branch offices, or write us.



Wagner 500 kva Noflamol Unit Substation Transformer installed at Nutley, New Jersey plant of Hoffmann-LaRoche, Inc.

Wagner Electric Corporation EST. 1891

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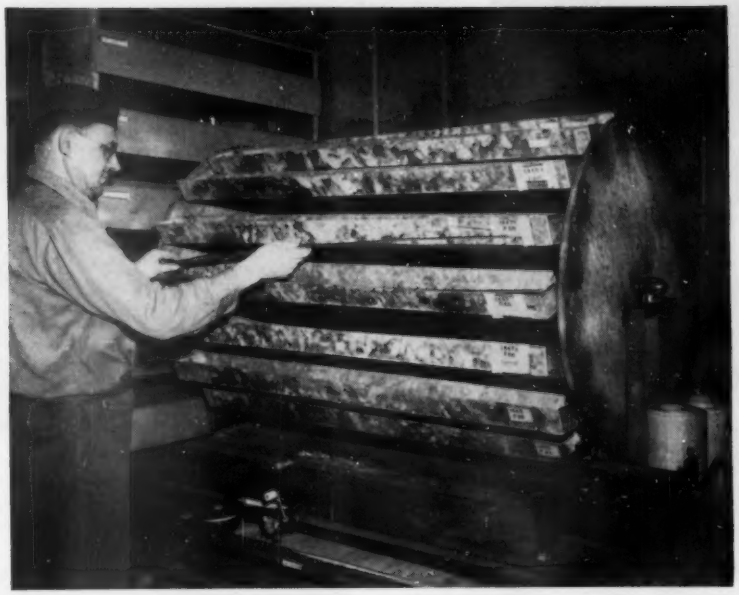


Rotary Trough-Rack For Slot Insulation

It's a lot easier to rotate a bin or turn a wheel-rack to bring repair parts into view than to fumble blindly with your hand in a trough or stationary bin. That's the premise on which mechanics at Lakore Electric Co., motor repair shop in Winona, Minn. operate. When they want wedges, slot insulation or insulating tubing of various sizes, they don't want to waste time looking or picking at random.

Their solution to the problem was the design and construction of a handy rotating rack that brings storage troughs into view as the unit is slowly turned by hand. There are a total of 17 metal troughs—each 50 inches long, 5 inches wide and 2½-inches deep. These are bolted, in ferris-wheel fashion, to two end disks to form a squirrel-cage type of unit. The troughs swing freely on their mountings so they will not tip or spill their contents as the unit is turned. Each trough holds a supply of wedges, slot insulation, tubing, etc., of specific size and is suitably labeled to identify its contents.

The 32-inch diameter disks at each end are cut from ¾-inch plywood; rotate on a center shaft supported by pillow blocks on 1½-inch angle-iron A-frames bolted to the table top; are high enough above the table to give clearance to the troughs as the unit is turned.

When a mechanic wants a length of wedge, insulation or tubing, he merely rotates the trough-rack until the properly identified trough "comes up" within easy access. He can even tip the specific trough to peer inside and pick just what he wants. It's quick, easy and pays off in man-hour economy.

Spray Booth Is One-Sheet Unit

When a large spray booth was needed by Lockwood's Electric Motor Service, Trenton, N. J., none of suitable size was available, so this shop made its own from a single sheet of 3/16-inch flat steel measuring 3 feet deep. The unit is 4 feet high at the sides but has an arched top to give necessary head-room should an employee wish to enter the booth.

Since the booth is located next to a concrete-block exterior wall, a metal back was omitted from the booth. Exhaust is by means of a 2-foot wall-inserted fan.

The booth will accommodate the largest motor handled by the shop, or it can be used to contain several smaller units simultaneously.

For added support, angle irons were welded around the edges.

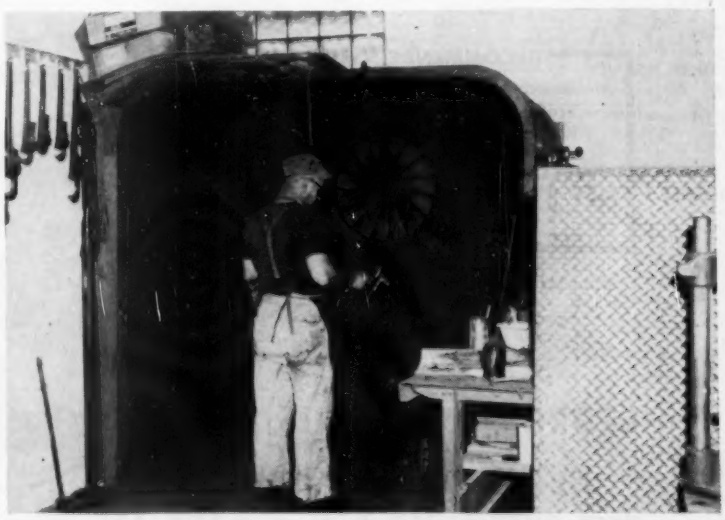
C-Frame Reaches Inside Car Trunks

Most motor repair shop operators often face the necessity of loading and unloading motors in passenger car trunks. When customers are in a hurry they pick up and deliver motors with the first available means of transportation. And that's usually someone's car.

Small motors that can easily be lifted by hand are no problem. It's the larger and heavier units that are difficult. Some that come into shops really flatten the rear springs of the car. In older model cars the units usually can be pulled out to the bumper, then lifted by hoist. Late model cars, with the rear body lip design create additional problems. There is not enough clearance when the trunk lid is up to drop the hoist hook into the trunk. How, then, can a motor be lifted out?

The answer—a large C-hook—appeared among the Award Contest entries at the 1953 NISA Convention in New York. In fact, it won first prize.

Bob Bonham of Phoenix Electric Company in Mansfield, Ohio, liked the



BUILT AGAINST EXTERIOR WALL with high-capacity exhaust fan, this spray booth is formed by single sheet of angle-reinforced steel.

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Insulating Varnishes

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C-FRAME ON HOIST reaches inside passenger car trunk to load or unload motor; makes this operation a one-man job. Arms of channel frame provide a 36-inch reach.

SWIVEL HOOK on bottom arm gives additional maneuverability inside car trunk. Frame lifts motor out of trunk without touching body or trunk lid.

idea so much that he had a unit made immediately upon returning from the convention. He incorporated a few refinements and it wasn't long before he was using this handy shop equipment item.

Bonham's C-frame is constructed of 3-in. by 2-in. heavy-web steel channel; has a 36-inch "reach" to get inside trunks; and is approximately 36-inches high. A lifting-ring welded to the top of the "C" slips over the hoist hook. A swivel hook on the bottom "arm" engages the motor ring or short sling. Further back on the top arm is a second hoist-hook ring for better balance and maneuverability if the motor has to be moved some distance in the shop.

Here's how the C-frame works. The passenger car is backed up to the hoist position and the trunk is opened. The

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This was proved by tests, comparisons and experiences

That there is a difference in dry-type transformers was revealed in the findings of a survey made by PLANT ENGINEERING, a trade publication, which mailed 500 questionnaires to users of dry-type transformers. (A copy of this survey report will be sent on request.)

Most of the users who returned questionnaires reported having very favorable experiences with air-cooled dry-type transformers. A number of unfavorable reports listed the following reasons: "Some makes won't even handle their rating." "Some are very noisy." "Primary shorts." "The insulation breaks down without overload in relatively short time." Some recommended "mounted lugs for connections."

The unfavorable comments above *do not apply* to Sorgel air-cooled dry-type transformers.

SORGEL air-cooled dry-type transformers are guaranteed to carry the full rated load continuously, and are so liberally designed that they can safely carry an overload during an emergency. They are well known for their quiet operation. All are equipped with solderless terminal lugs.

Because these superior features cost more to incorporate in Sorgel air-cooled transformers, our price may not always be the lowest; however, the little additional price you might sometimes pay will be saved several times over in extra service and lower installation costs.

We spare nothing to maintain the highest quality in our air-cooled dry-type transformers.

SORGEL air-cooled dry-type transformers are top quality, time-tested, and are therefore recognized and accepted by discriminating engineers and users.

These transformers are available in a large variety of sizes and types for every purpose. ¼ Kva to 1000 Kva single phase. 1 Kva to 3000 Kva 3-phase. All standard voltages, such as 120, 208, 240, 480, 600, 2400, 4160, 4800, 7200, 13,200 and up to 15,000 volts, and any intermediate or special lower voltages.

SORGEL dry-type transformers are also incorporated in substations, complete with primary and secondary switch gear.

The Sorgel Electric Co. has had over 35 years of uninterrupted experience in the development, manufacturing and application of dry-type transformers.

Stock carried in the following cities:

Chicago, Illinois
Cleveland, Ohio
Los Angeles, Calif.
Milwaukee, Wis.
Rock Island, Illinois
Rockford, Illinois
Richmond, Indiana
Davenport, Iowa
Cedar Rapids, Iowa
Omaha, Nebraska
Roxbury, Mass.

Consult the classified section of your telephone directory or communicate with

SORGEL ELECTRIC CO.

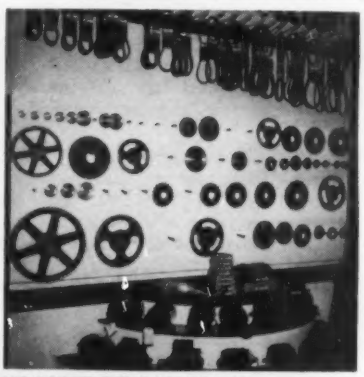
836 West National Ave., Milwaukee 4, Wis.

WHEN HOOK IS folded back on top channel, lower arm rests flat on floor for easy storage of C-Frame.

lower arm of the frame is pushed inside the trunk and the motor attached to the swivel hook. The hoist then raises the C-frame until the motor clears the body lip. The hoist is backed up, or the car pulled away, and the motor is in the clear without either frame, motor or hoist chain touching either the trunk lid or car body. The 360-degree swivel of the frame hook provides additional freedom of motor movement inside the trunk if necessary.

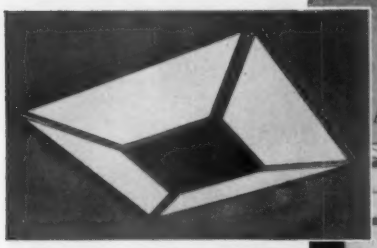
When the frame is not in use it can be stored against a wall or behind parts shelves or cabinets. The hook folds back on the top of the channel so the lower arm rests flat on the floor.

Phoenix personnel are extremely well pleased with this idea. It has drastically reduced the man-hours required to unload car trunks and minimized the possibility of damage to the customer's safety by eliminating manual lifting.

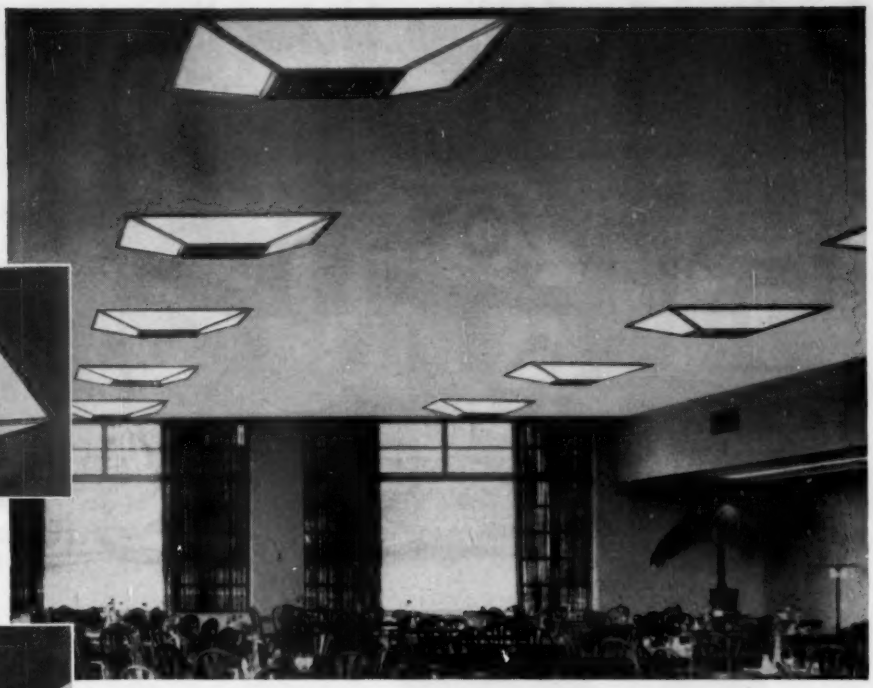


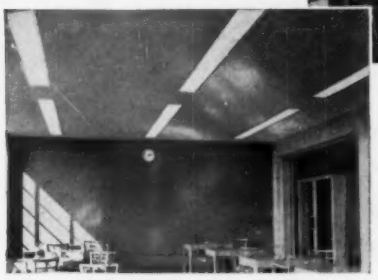
SPROCKET DISPLAY BOARD at the A. G. Lakore Electric Motor Repair, Inc., shop in Winona, Minn., helps advertise and sell chain transmission drives; makes it easy for customer coming into shop to match sprockets for replacement. Board has space for 62 different sizes and types. Note V-belt racks above.

Project: Manhattanville College, Purchase, N. Y.
Architects: Eggers & Higgins, New York, N. Y.
Fixture Manufacturer: Gruber Bros., Inc., Brooklyn, N. Y.
Lightingware: CORNING Alba-Lite and PYREX brand Lenslites



In dining room, air conditioning diffuser is integrated with lighting fixture. Light is pleasantly diffused by Corning Alba-Lite.





Classrooms, assembly hall, and corridors feature recessed fixtures also shielded with Alba-Lite low-brightness lightingware.

Stage of music auditorium is lighted with 32 recessed incandescent units shielded with PYREX brand Lenslites.

New ideas in lighting for girls' college realized with Corning lightingware

The ingenious combination of air conditioning with engineered lighting for *five* new buildings of Manhattanville College for Girls offers interesting possibilities for almost any type of building.

For example, in the dining room, air conditioning outlets are integrated in large fluorescent fixtures. Each one containing 24 lamps using a total of 600 watts. Sloping shields of Corning Alba-Lite diffusing glass afford low-brightness illumination of the proper intensity for dining.

In the assembly hall, three air conditioning outlets are spaced in each of seven rows of continuous recessed troffers. Alba-Lite is used here also. It provides diffuse, high-level illumination, free of direct glare and harsh ceiling contrast.

Over the music stage of the auditorium, 32 incandescent units are shielded by PYREX brand Lenslites effecting a wide angle cutoff of the 150-watt lamps. They create a blanket of light of high intensity.

Corning offers a wide range of diffusing lightingware as well as Lens Panels and Lenslites. You will find these products adaptable to any lighting problem. Bulletin LS-43 tells you how to figure requirements. Send for it today.

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CORNING, NEW YORK

Corning means research in Glass

CORNING GLASS WORKS, Dept. EC-2, Corning, N. Y.

Please send literature checked:

- ☐ Architects and Engineers Lighting Handbook.
- ☐ Corning Lightingware for Fluorescent Lighting.
- ☐ Corning Lens Panels and Lenslites.

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- You just can't beat these small drop head dies for quick easy pipe or conduit threading.
- Snap the size head you want into the drive ring, from either side, and you're ready to cut clean perfect threads . . . heads can't fall out.
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- OOR and OR, 1/8" to 1"; 111R and 11R, 1/8" to 1¼"; 12R, 1/8" to 2". Free carrier with sets. Every threader fully work tested before shipment. Buy them at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

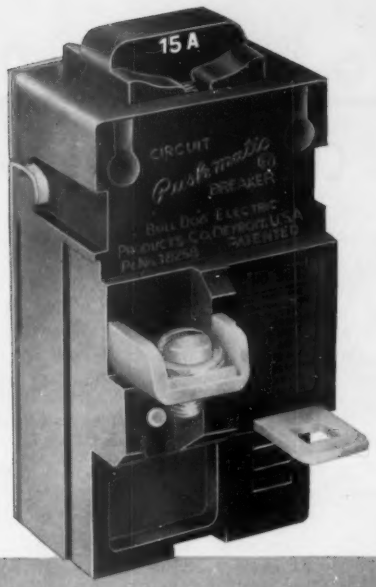
RIDGID
Work-Saver Pipe Tools

Plywood Turntable Is Workbench Time-Saver

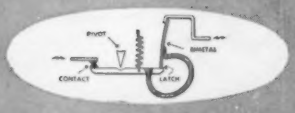
Dropping or mislaying small parts is a thing of the past in the shop of the Central Armature Works, Washington, D. C., since circular plywood turntables were installed over the work benches. These turntables are mounted on vertical pipe supports, can revolve freely and are drilled with a series of various-diameter holes.

When workers wish to keep small parts or tools off the top of the crowded benches they can place them in any of these holes, then have little difficulty locating or retrieving them when needed. It also keeps parts free from lint, grease or other debris. Turntables can be spun around to provide access to all holes, and the 15-inch-diameter wooden platforms have sufficient storage space for all equipment and parts normally related to the repair of a small motor.

FRIENDSHIP of long standing is renewed regularly at industry meetings by Milwaukee electrical contractors Lester J. Fieldhack (left) residential and commercial specialist; and W. J. Bentley, whose activities are primarily in the industrial and commercial field.



ONLY BULLDOG DUO-GUARD PUSHMATICS PROVIDE DOUBLE PROTECTION



Simplified diagram of thermal element. Overloaded circuit heats bimetal, causing it to expand. Latch is released and pulled upwards by steel spring, breaking circuit.

Simplified diagram of magnetic element. High overloads or shorts set up magnetic field in coil. Magnetic field instantly activates metal plunger which releases latch. Spring pulls latch upward, instantly breaking the circuit.

Duo-Guard Pushmatic circuit breakers provide double protection because they use *separate* protection elements. Only BullDog Duo-Guards have both a thermal element and a wound-coil magnetic element.

The thermal element (bimetal strip) protects branch circuits from "normal" overloads, and guards against nuisance tripping. The magnetic element (wound coil solenoid) protects branch circuit wiring and insulation, and properly connected lamp and appliance cords, against damage from shorts and dangerous overloads of high intensity.

Add BullDog's exclusive push-button control to the Duo-Guard feature, and you have the world's most efficient circuit breaker. No other breaker—at any price—offers as much. Many cost more. Get complete details about the Duo-Guard Pushmatic—the standard BullDog breaker—and Electri-Center panelboards. Write, today, for free new Bulletin PM-365. BullDog Electric Products Company, Dept. EC-24, Detroit 32, Michigan.

©BEPCO

Extra protection at 20 amp.

The new 20-amp. Duo-Guard provides the same short-circuit protection as the 15-amp. Cords, lighting, appliances and branches get quicker acting protection from dangerous electrical faults. At the same time, the 20-amp. Duo-Guard carries its full-rated load and prevents nuisance tripping.

THOROUGHBRED IN ELECTRICAL EQUIPMENT

BULLDOG
ELECTRIC PRODUCTS COMPANY

Practical Methods

Automatic Angle-Indicator Speeds Conduit Bending

Instrument is more than twenty times faster than method previously used.

Every mechanic has a streak of inventive ingenuity in his makeup. Look in on any construction project and you will find interesting gadgets developed to solve specific installation problems. The common goal is to do a job quicker, better and, understandably, with less effort on the part of the mechanic. The huge United States Atomic Energy Commission plant under construction near Paducah, Kentucky, proved a fertile ground for new ideas of this type. Each trade came up with a number of unique devices applicable to its specific field.

Among numerous devices developed by electricians of A. S. Schulman Electric Co. (chief electrical contractor under prime A.E.C. contractor F. H. McGraw & Company) was an automatic bend-angle indicator designed by electrical foreman Elmer Cowell. When attached to the end of a conduit length, it speeds precision bending of offsets.

The device was the outgrowth of Cowell's cumulative impatience with the time required to make conduit offsets and bends, even with power-operated hydraulic benders. There was always the repetitive checking of angle on multi-step bending operations. Probably the oldest method was comparison with "angle-sticks" — two pivoted sticks that could be adjusted to match various angles (marked on a table) required for the series of offsets involved in making a 90-degree bend. After each partial bend, the sticks were placed against the conduit for comparison. They were readjusted for the next angle in the multi-step operation. Cowell estimates that it took an average of two hours to make a 90-degree bend by this method—much too long to suit him.

The first improvement involved the use of a combination protractor-level. This instrument was placed on the end of a conduit length, with a screw indicating the desired bend-angle. When that angle was reached, during the bending operation, the air bubble in the level settled between two red lines. Bending time was reduced to about one-fourth (of that with "angle-sticks") but it was an eye-straining chore and Cowell still was not satisfied. It would be an advantage to find a way of eliminating the need for presetting the angle of bend and to provide an indicating method that would be more readily visible to the operator of the bender motor.

After experimenting with a few more ideas, he decided to add a free-swinging needle indicator to a protractor. He obtained the bearing and needle from an old ammeter, added a lead-tube weight to the bottom of the needle. Next, he mounted a plastic protractor to a semi-circular piece of sheet steel painted white and extended the angle-lines and degree indications to the periphery of the metal disc. The weighted needle assembly was mounted to the disc in such manner that the arrow pointed to zero when the protractor base was level. A metal set-screw clamp was fashioned to mount the instrument to the conduit.

This is how the instrument works. The clamp is mounted to the conduit so the metal disc is in a perpendicular plane. Before the conduit is bent, the needle remains vertical and points to zero. As the bender pressure is applied and the conduit end bends upward, the weighted needle still remains vertical but the protractor (and metal disc) begins to move in an arc. The point of the needle then indicates the angle of bend. When the pre-determined angle is reached, the conduit is advanced in the bending shoe and the next bend is made. This is repeated (with the instrument still intact) until the desired offset is made.

Biggest advantage is that the mechanic operating the hydraulic motor can get a direct reading of bend angle from the instrument and can control the motor accordingly. Cowell estimates this new gadget cuts bending time to one-third of that required by the protractor-level and a twenty-fourth of that required by the old "angle-stick" method. Among improvements he plans to make is the addition of a magnet base for quick attachment of the instrument to conduit, thus eliminating time now spent in fastening the clamp.

DIRECT READING INDICATOR attached to end of conduit shows angle through which conduit is being bent. Electrical foreman Elmer Cowell (center) watches instrument he designed, as electricians L. L. Young (left) advances conduit in bending shoe and Jack Arwine operates hydraulic bender motor. All are employed by A. S. Schulman Electric Co. (Chicago) at the A.E.C. project near Paducah, Kentucky.

THIS IS THE MOTOR of a production grinder. Note dust and coolant on SEALTITE protecting lead wiring.

How to keep foul-up and corrosion out of your lead wiring

Use SEALTITE. Its tough outer cover resists all enemies of motor lead wiring.

You can spray your wiring with oil . . . douse it in water . . . cover it with dirt . . . expose it to corrosive fumes . . . even let salt spray and chemicals do their worst—*without fear of foul-up and corrosion*—IF you run it in SEALTITE* Electrical Conduit. A special outer cover takes them all in stride.

Yet tough as it is, SEALTITE is light and flexible. It installs easily in cramped spaces. It absorbs vibration—takes movement. It hugs motor contours. It looks neat.

*Trademark

Liquid-tight SEALTITE is the first conduit of its type to be approved by Underwriters' Laboratories, Inc. for use where exposed to moisture and mineral oils. (See N.E. Code, Art. 351.) For tight bends on machine tools and industrial equipment, use SEALTITE Type EF (Extra Flexible), which meets standards set by J. I. C.

Electrical Supply Houses stock both types in coils. Buy it this way; then cut without waste. Jobbers also stock liquid-tight fittings for use with SEALTITE.

SEALTITE
flexible, liquid-tight electrical conduit
an ANACONDA* product

The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn.

Please send me descriptive booklets on SEALTITE Electrical Wiring Conduit. 54171

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COMPANY.....

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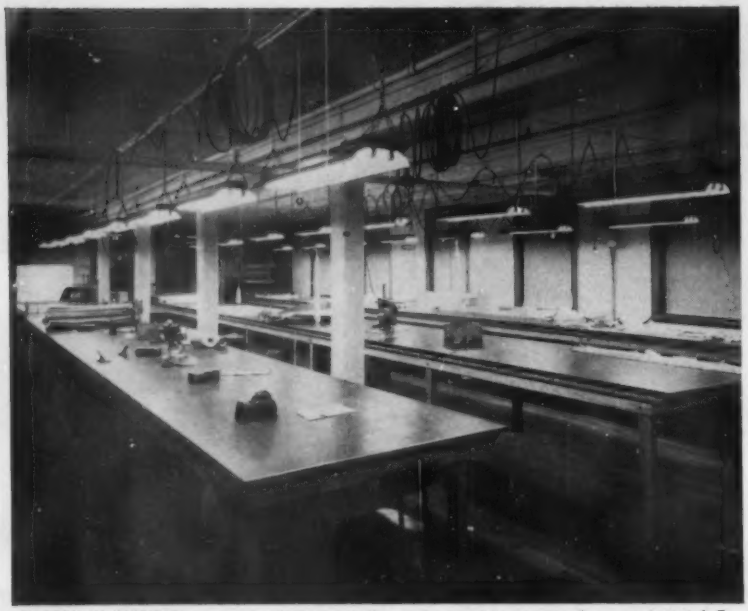


CUTTING TABLES receive adequate light and portable power from industrial 2-lamp fixtures and extension cords suspended from messenger cables.

Versatility Obtained By Simple Installation

ENGINEERING

Friedman Electric Company, contractors for the Formaid Company of Boston, Mass., made use of a number of available products and materials to produce a flexible, economical, effective installation to serve a series of cutting tables. To deliver an average of 60 footcandles of illumination to the working plane, industrial reflectors mounting two cool white 40-watt fluorescent lamps were suspended 4 feet above the table tops on 6-foot centers. Then, to provide flexible power for cutters, coiled extension cords were suspended by clips to messenger cables strung along the ceiling immediately adjacent to the lighting fixtures, making it possible to keep the cords neatly out of the way yet provide power at any desired working point. The installation is a simple one yet, through the judicious selection and use of basic materials, the results are quite adequate and acceptable to the owners.

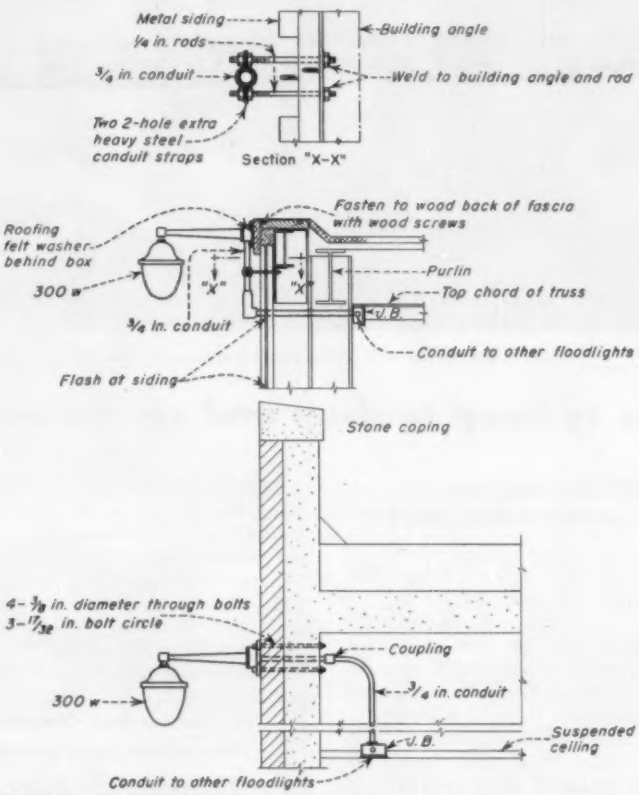
Installation Details for Wall-Mounted Floodlights

INSTALLATION

Two practical methods for connecting exterior wall-mounted floodlight units to interior circuits are utilized at the Hamilton-Standard propeller plant in Windsor Locks, Conn., where outdoor lighting of a high order is installed for protection of property, safety of personnel, convenience and architectural attractiveness.

One of these methods is used to mount 300-watt units to the coping of factory walls, which are sheathed with metal formed sections. Since the walls are capped by wooden sills and metal flashing, the horizontal arms of the lighting fixtures are secured directly to the wooden members by means of wood screws. The circuit lead-in conduits do not enter the building at these points, however, but are carried downwards along the exterior face of the walls to points opposite the top chords of roof trusses, then make right-angle turns by means of standard condulet fittings, and pierce the vertical face of the building. As shown, the vertical conduit drops are held securely by means of yokes formed from 2-hole extra-heavy conduit straps, while the straps are clamped back to back on threaded ½-inch rods that pierce the wall surfaces and are welded to angle irons on the inside of the structure. All entrance points are flashed.

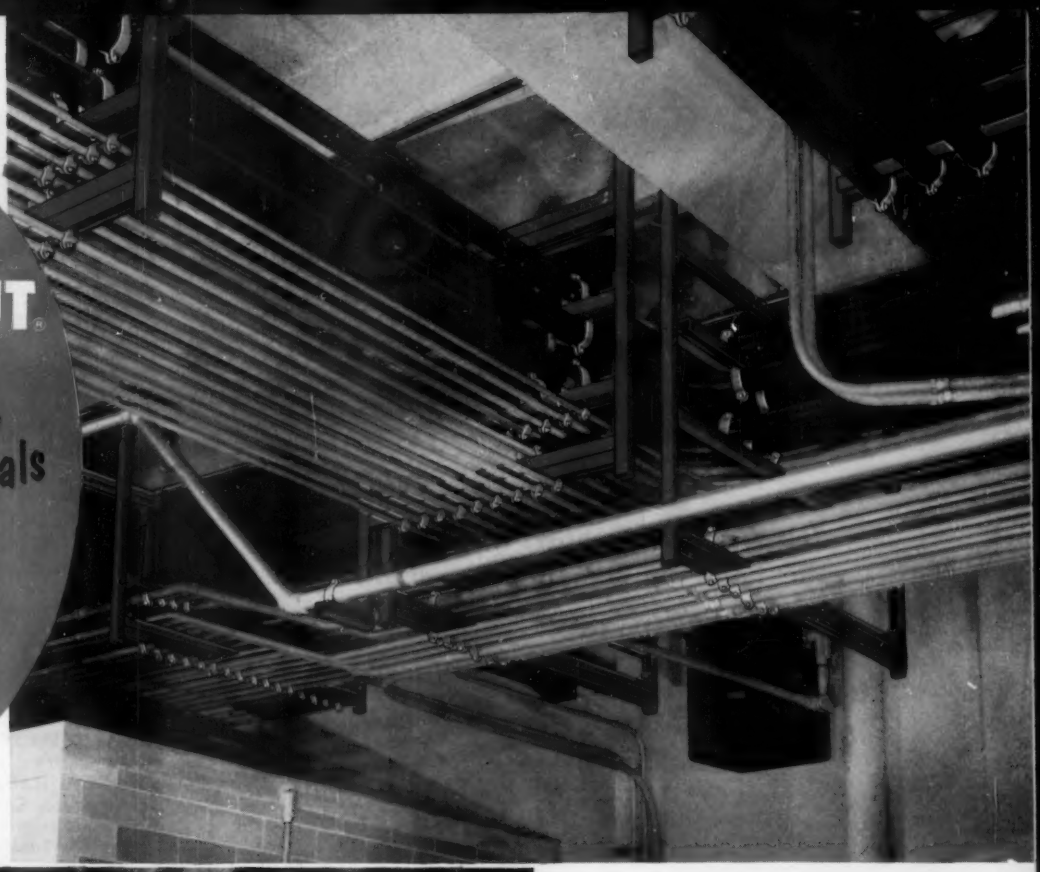
A second method is used where a similar 300-watt luminaire is mounted several feet below the coping of a reinforced-concrete wall faced with brick. Here the horizontal arm and base are held snugly in position by means of thru-bolts, and the conduit lead-in enters the building at this same point, connecting to the interior conduit system by means of a coupling.



EXTERIOR LIGHTING FIXTURES are attached to wood sills by means of screws and to masonry walls by thru-bolts. Lead-in conduits enter the building through the vertical face of the building.

UNISTRUT concrete inserts, steel channel, fittings and clamps support maze of conduit in trapeze style framework.

ADJUSTABLE UNISTRUT® FRAMING saves time, space, materials in large chemical plant



View shows how UNISTRUT nut and bolt assembly permits speedy erection, changes or additions at any time.

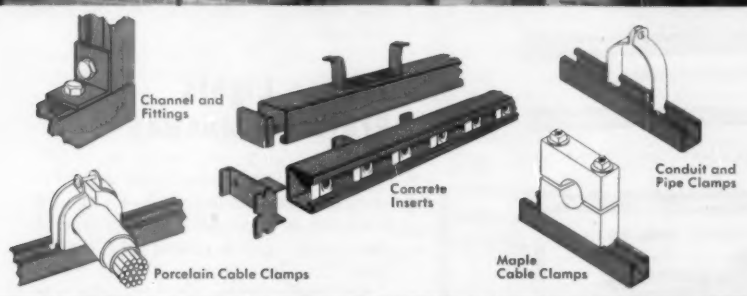
Conduit and Cable Installed Faster, Easier, for Less, at Kaiser Aluminum & Chemical Corporation's new Chalmette, La. plant

Versatile UNISTRUT steel structural supports reduce engineering detailing, permit rapid, on-the-job erection, allow changes or additions at any time.

This simple-to-assemble framing system consists of steel channel and fittings, clamps, brackets, hangers and concrete inserts—provides all you need to mount, frame, suspend or support all kinds of electrical equipment with just a hacksaw and a wrench.

No drilling, no welding, 100% adjustable and re-usable—there is no waste. Try UNISTRUT framing on your next job!

See our complete catalog in Sweet's Architectural, Plant Engineering and Industrial Construction Files.



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Write for FREE 84-page Pocket Catalog No. 800
For the MAN ON THE JOB. Photos, drawings, ideas and data on how to frame, mount, rack and support electrical and mechanical equipment with UNISTRUT metal framing.

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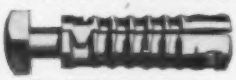

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STUD BOLT ANCHOR

LEAD SCREW ANCHOR

MAL-LEAD BOLT ANCHOR

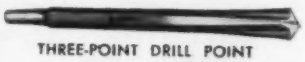
TWO WING SPRING-TYPE TOGGLE BOLT

SPRING HEAD STEEL TOGGLE BOLT

RIVETED HEAD TOGGLE BOLT

LITTLE MAJOR TURNBUCKLE

FOUR-POINT HAND STAR DRILL



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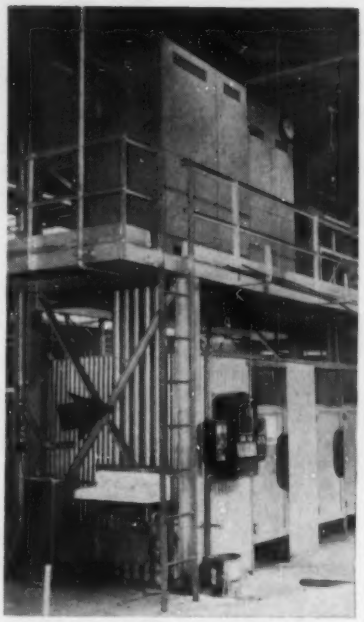
RUBBERGRIP DRILL POINT HOLDER

See your industrial, hardware or electrical supplier

ARRO EXPANSION BOLT COMPANY

1540 Boone Ave., Marion, Ohio



ELEVATED SWITCHBOARD is the heart of the electrical distribution system at Michel and Pfeffer Iron Works, South San Francisco, Calif. Part of the electrical installation made by Emil J. Weber Electric Co., San Francisco, this board is fed at 480 volts, 3-phase, 3-wire, from a bank of three interconnected single-phase, 11,000- to 480-volt, dry-type transformers outside the building. The transformers belong to the utility and are on their 11-kv network in that area. From the outside transformer bank, six 4-inch conduit-runs, with 3 750-MCM VCL conductors in each, are carried underground to the center of the one-level plant, then up to the switchboard (ARROW). Distribution feeders from the board supply 480-volt power to the machinery in the plant. Lighting is tapped off the board through three single-phase, 25 kva, transformers. From the 3-phase, 4-wire, Y-connected secondaries of this 480- to 120/208-volt transformer bank, lighting circuits are balanced on the phases and feed industrial type fluorescent units using 96T-12 Slimline lamps.

Traffic Lights Protect Craneway

SAFETY

There's little chance that a 15-ton steel-handling crane will lower the boom on an unsuspecting employee in the plant of the Standard Pressed Steel Co., Jenkintown, Pa.

Red traffic lights—similar to the type used at railway crossings—now flash a warning whenever the overhead crane approaches any one of three heavily traveled cross-aisles.

Concerned lest a misplaced load land on an unwary passerby, the SPS firm, producers of socket head screws, installed sets of photo-electric eyes to

THE ONE FULL LINE OF SAFETY SWITCHES BACKED BY TWO FAMOUS NAMES

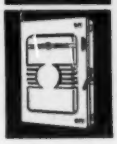
Trumbull low voltage switches are designed by the safety switch pioneer . . . built to world-famous *General Electric* engineering standards of safety and performance. Priced competitively, engineered and built to give you extra value, switch for switch, dollar for dollar.

Trumbull Heavy Duty Style HCI Switches are designed to exceed NEMA Type A requirements and provide for future needs. They offer extra high interrupting capacity and mechanical durability, plus the convenience and compactness of front operation with semi dust-tight features standard.

Trumbull Heavy Duty Style A Switches, available through 1200 amperes, provide exceedingly long life under severe operating conditions. These rugged switches have long been the standard of the industry.

Trumbull Standard Duty HCI Switches meet NEMA Type A requirements. These switches also contain the revolutionary new HCI (High Capacity Interrupter) pole unit—the most talked of safety switch feature in many years.

Trumbull General Use Safety Switches are designed primarily for disconnects at service entrance or as disconnects on light equipment—for applications requiring infrequent operation.



Write for Bulletins on the G-E line of Trumbull Safety Switches. Trumbull Components Department, General Electric Company, Plainville, Connecticut

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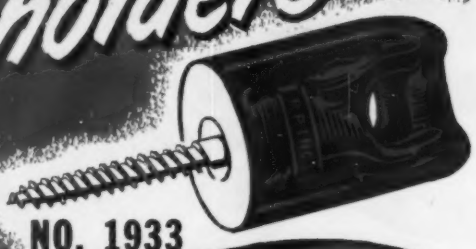
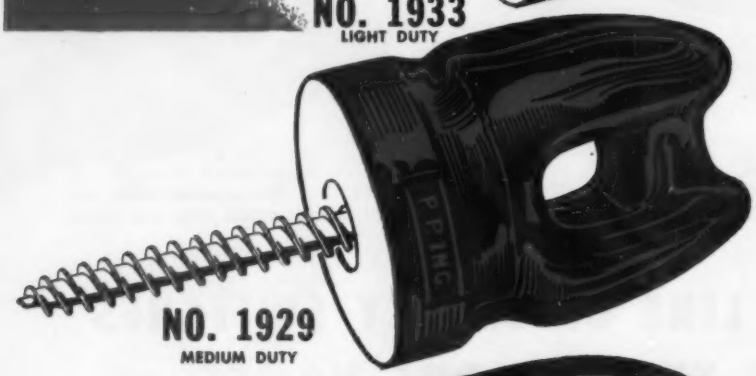
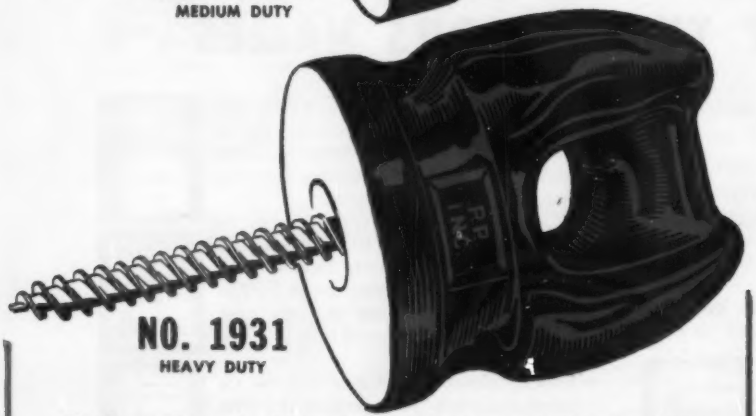


NO. 1933
LIGHT DUTY



NO. 1929
MEDIUM DUTY

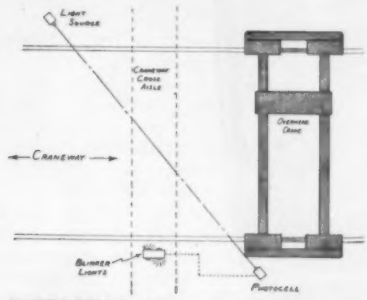


NO. 1931
HEAVY DUTY

Here's your best value for service entrance work. These all-porcelain wireholders have no exposed metal parts to rust. They're designed to stand up under far greater wind, weather and cable loads than will ever be required under excessive conditions of ice and storm. And they're economy-plus, both on initial cost and long life. Insist on PP better quality insulators . . . stocked by leading distributors.

Porcelain Products, Inc.
FINDLAY, OHIO

TRAFFIC LIGHTS in craneway automatically blink red to warn employees when 15-ton crane is near cross-aisle, promoting safety in Standard Pressed Steel Company's plant, Jenkintown, Pa.



PHOTOCELLS keep watch, start red traffic lights to blinking when crane comes within 20 feet of center of cross-aisle. Craneway is 335 feet long, has three busy cross-aisles.

keep watch over each cross-aisle. SPS connected the "eyes" to blinker type warning lights—one suspended over each intersection at a height of 12 feet.

Now when the crane comes within 20 feet of the centerline of an aisle it interrupts a photo-electric beam. The red lights in the "danger" aisle immediately start blinking, and continue to flash their warning until the overhead crane has safely passed.

Actually, cross traffic does not come to a halt when the red lights start flashing. There's no immediate danger in having a crane, loaded or not, moving overhead. But the lights do warn SPS pedestrians to be on their toes.

The new warning system, a plant-made device, cost SPS less than $250 per aisle—the cost of the photocell units, the traffic light and the necessary controls and wiring.

The protected craneway, in which the firm stores steel bar and coil stock to be made into screws and locknuts, extends for 335 feet through the receiving end of the plant. The three cross-aisles are each ten feet wide.

For any splicing or insulating job—
there's a "U. S." Tape

HOLDTITE® FRICTION TAPE

This is the strong, tacky tape that really grips and stays on. The fabric has unusually high tensile strength to handle *any* electrical or general purpose job. Non-ravelling, straight-tearing. No pinholes to cause leaks. U.S. Holdtite exceeds A.S.T.M. Specifications.

HOLDTITE RUBBER TAPE

For durable splices on all general electrical work. Holdtite is an unvulcanized rubber splicing compound with high tensile strength, high elongation and tackiness plus dielectric strength. Electricians like its "feel". Easy to handle, pulls down tight and *fuses* quickly into a solid mass without heat or undue pressure. Insures long-aging splices. U. S. Holdtite exceeds A.S.T.M. Specifications.

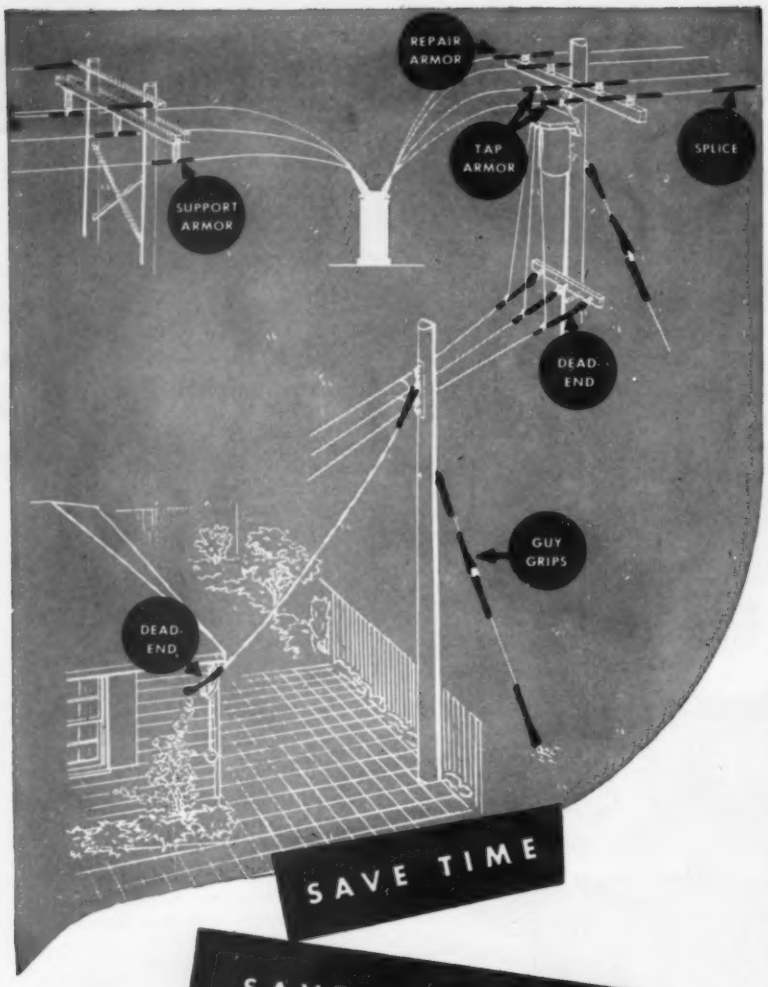
ROYALASTIC PLASTIC TAPE

For making a thin splice and keeping wiring neat and uncluttered, many maintenance men find Royalastic is best. It does the work of both rubber and friction tape in many uses. Complete mechanical and electrical protection. High tensile strength and excellent resistance to abrasion and to water, oils, acids, alkalies and corrosive chemicals. Good stretch, pulls down tight, stays on. Approved by Underwriters' Laboratories, Inc.

When you need industrial tape, simplify your purchasing by ordering from a single source— one of our numerous distributors or direct from one of our 25 District Sales Offices. Put your order in now.

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.



SAVE TIME

SAVE MATERIAL

SAVE MONEY

go Preformed

The Preformed Products shown above are establishing new service standards. Not only do they save countless man-hours of installation time, but also they assure a uniformity and efficiency of application unattainable by any comparable devices. They require no clips or clamps and can be installed easily by hand in most cases.

For complete details of their exclusive advantages, write or telephone Cleveland: EXpress 1-3571

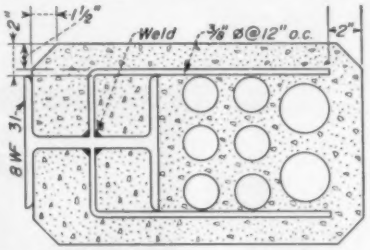
PREFORMED LINE PRODUCTS CO.
5349 ST. CLAIR AVENUE, CLEVELAND 3, OHIO

Risers Incorporated In Structural Columns

INSTALLATION

When elevated load-center sub-stations, testing platforms or concentrations of risers are located around or adjacent to structural columns in industrial buildings, vertical conduits may be incorporated with the structural members to form streamlined, attractive and sturdy concrete pillars. This practice was followed by Albert Kahn Associated Architects and Engineers when they designed Hamilton Standard's new propeller plant in Windsor Locks, Conn., the electrical work for which was installed by the Lord Electric Company, Boston.

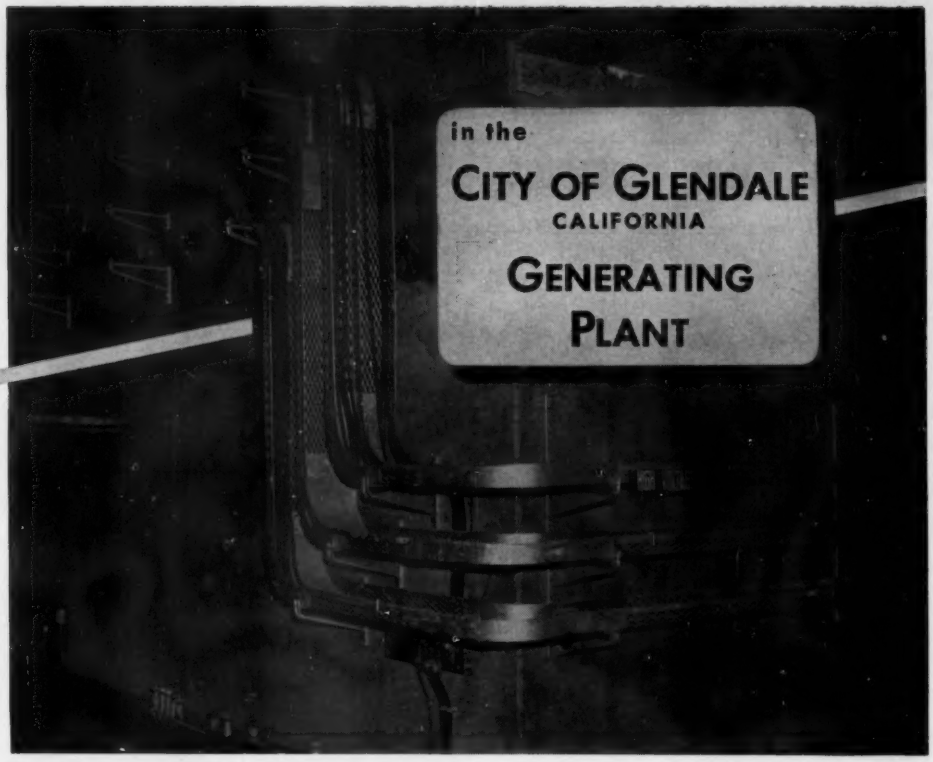
Using 8-inch wide-flange H columns as the nucleus, ⅜-inch round bars were bent to form L shapes, then were welded on 12-inch centers to the web of the column as shown in the accompanying diagram. All electrical risers



ELEVATED PLATFORM for the support of a load center or testing station may be constructed around a structural column, with risers enclosed by bent reinforcing bars welded to the column web as shown and sheathed in concrete to form a clean, attractive, sturdy upright.

were positioned between the arms of the enclosing L members, and the entire assembly was sheathed by a concrete envelope approximately 2 inches in thickness. With the L's positioned as shown, the conduits were confined and protected from physical injury during the pouring stage, and they also serve as reinforcing members for the completed columns.

EMIL J. WEBER, president of Weber Electric Co., San Francisco, Calif., does considerable school construction and electrical modernization work.



Cope CABLE TROUGH AGAIN PROVES ITS

... Simplicity of Installation
... All-around Economy
... Accessibility to Cable

The versatility and simplified design of the Cope system of Cable Trough and Fittings make it readily applicable to any layout. This is clearly seen in the above photograph showing part of a recent installation at the Glendale Generating Plant. Notice how the Cope Trough is supported by simple wall brackets. Observe, too, that both vertical and horizontal runs are made with standard trough and fittings — turns, branches and reductions.

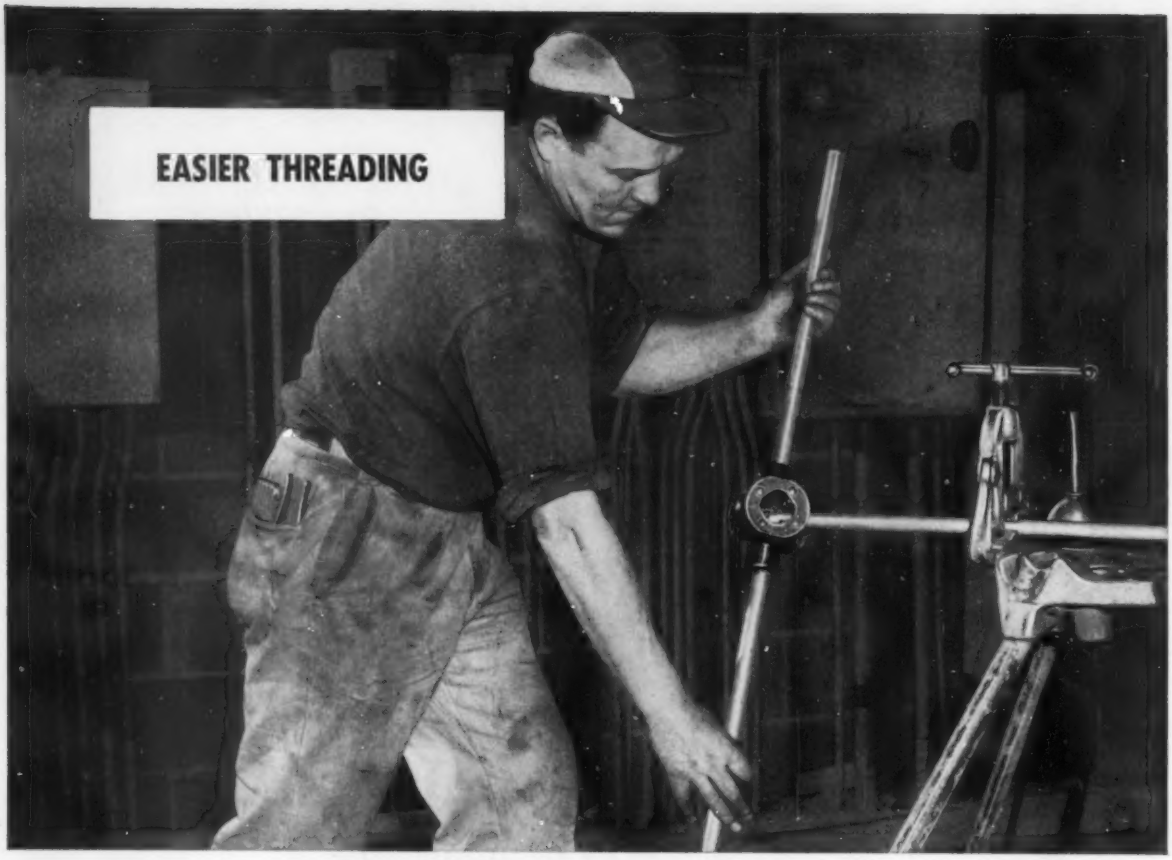
The High Voltage sign on the top tray emphasizes another Cope Trough feature. Here 480 volt Neoprene jacketed power cables are carried in the same tray with control cables. A barrier strip provides adequate separation while permitting easy access to the lines. The lower tray will carry 2400 volt Neoprene jacketed power cables and ultimately will be equipped with a solid Cope Trough cover. Future expanding needs will be met by adding a fourth tray above the other three.

Learn how you, too, can cut cable installation costs and labor . . . write for bulletin on Cope Cable Trough.

T.J. Cope INC.

You know Cope by these products

711 SOUTH 50th ST., PHILADELPHIA 43, PA.



Another reason why...

NEW G-E WHITE CONDUIT IS EASIER TO HANDLE

Electrical contractors are applauding another important quality that makes the new G-E WHITE rigid steel conduit faster to install—the ease with which it can be threaded. The metallizing process used to apply the zinc coating to G-E WHITE produces a unique structure which acts as an ideal cutting lubricant. This process also assures easier bending and outstanding corrosion protection.

G-E White is lined with a new corrosion-resistant coating, containing a special antifriction agent that lets wires slide freely and cuts fishing and wire-pulling time. It's listed by Underwriters' Laboratories, Inc., and meets all Federal Specifications. To simplify conduit installations and guard against corrosion, ask your distributor about the new G-E White rigid steel conduit, or write Section C43-218, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

You can put your confidence in—

GENERAL ELECTRIC

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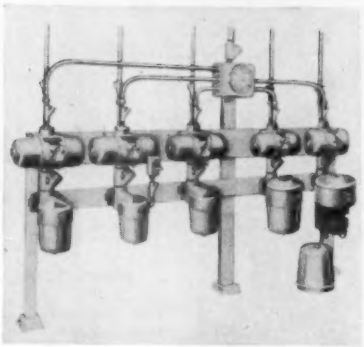
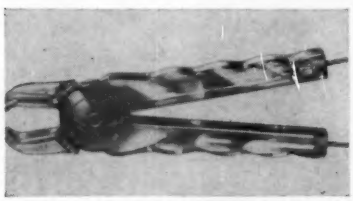
Product News



Enclosures (1)

A complete new line of explosion-proof, dust-tight, rain-tight circuit breaker, motor starter, and line starter combination enclosures. Called "Unilets", they carry U.L. approval. Each component Unilet for circuit breaker, motor starter, and seal, possesses full 7-thread engagement at the coupling joints as well as on bolt-free covers. Safe entrance to individual motor starters for maintenance work is assured in both single and banked combinations in hazardous areas without shutting off other branch circuits. No "live" circuit breaker wires are exposed while motor starter enclosure is open on a line starter combination. Other features include: U.L. approval on banked circuit breaker Unilets up to groups of three for Forms 1 and 2; lightweight construction; standardized mounting frames; simplified "straight-thru" wiring; versatile hub adapters, which permit use of over-size conduit and conductors; and pushbutton and pilot-duty control. Unilet line covers all breaker-starter control equipment of leading firms rated to 225-ampere breaker loads and to 100 hp on 3-phase induction motors at 600 volts maximum. Bulletin 12-A is available.

Appleton Electric Co., 1701-59 Wellington Ave., Chicago 13, Ill.



Tester and Fuse Puller (2)

A new test-light and fuse puller incorporating five design improvements. Unit is made of transparent red Tenite, hi-dielectric plastic. Jaws are shaped to hold all cartridge fuses up to 100 amp size. Inside surfaces of jaws are serrated. Handles are formed to fit fingers and corrugated to prevent slipping. Two 24-inch flexible leads are furnished with each tool. One lead has a 4-inch plastic handle prod, the other a spring clip with rubber jacket. Test light is neon type with a resistor, which meets Navy specs. When testing circuits, the light glows once on dc and twice on ac.

Holub Industries, Inc., Sycamore, Ill.

Wire Guides (3)

New D.Z. wire guides for pulling electric wires through conduits. When guide is used, no feeder is needed at start of conduit, regardless of how many wires are pulled through. Guide consists of a tempered steel spring attached to a lightweight knurled aluminum body which screws onto conduit. Smooth contours of spring end eliminate stripping and shaving of insulation on sharp edges of conduit or box. The guide is manufactured to standard conduit sizes of ½-, ¾-, 1-, and 1¼-in.

George G. Zachary, 10132 E. Rush St., El Monte, Calif.

Loom Switch (4)

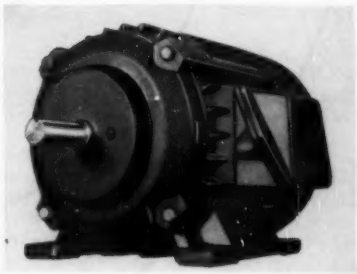
A new Type "LM" loom switch is a Size 0, across-the-line, manual starting switch for single or multiple shuttle textile looms, developed specifically for the textile industry. It is housed in a lint-proof enclosure of heavy gage, formed steel, with a free swinging hinged door and a balloon type, neoprene impression gasket. Mechanism consists, internally, of two complete and separate units, the main contacts and the overload tripping device. The overload tripping device utilizes knife blade contacts. The re-set lever is located within the lockable enclosure. To prevent unscheduled restarting, the "stop" button must first be pushed before switch can be reset thus protecting personnel. All wiring is brought to special terminal blocks and switch mechanism is secured to these. Other features are: ample wiring room, a self-locking cover latch, modern push-button operation, and solderless lugs on all terminals.

Arrow-Hart & Hegeman Electric Co., 103 Hawthorne St., Hartford 6, Conn.

Air Conditioner (5)

Leader Model consoles for 1954 include cooling thermostats on 1 hp units, and both electric heat and cooling-heating thermostats for automatic control of room temperature on 1½ hp units. They are made for commercial or industrial use, remote or built-in home installations, and for custom built enclosures. Where water and drainage are a problem, the air-cooled units may be used—singly or in multiple—in place of heavier equipment. Water cooled models are for use where openings to an outside air supply are unavailable. Duct work may be used with remotely located units. All consoles are supplied for 230 volts dc and ac for 208 and 230 volts, single and 3 phase, 60 cycles. Consoles of 1 hp are also supplied for 115 volts dc. Dimensions are 34⅜-in. wide by 37¼-in. high by 19-in. deep.

Remington Corporation, Auburn, N. Y.



Motors (6)

A new line of squirrel-cage induction motors, including protected and enclosed motors for all industrial purposes, built to NEMA standards. Available for 1-, 1½- and 2-hp applications, in frame sizes 182 and 184. The balance of the line, up to and including 30-hp, will be introduced later. The new totally-enclosed fan-cooled motors are built to operate under a wider variety of adverse atmospheric conditions and in any mounting position.

Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland 10, Ohio

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1639 W. WALNUT STREET

Chicago 12, Illinois

Panelboards (7)

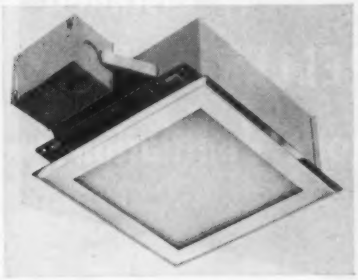
A complete new line of dust-tight circuit breaker lighting and distribution panelboards, especially designed for use in hazardous locations where combustible dusts are present. They meet the National Electrical Code requirements and standards for Class II, Groups E, F and G hazardous locations and are approved by Underwriters for use in Class II, Groups E, F and G hazardous locations. Enclosure consists of a formed steel box and front with welded corners. External, dust-tight handle mechanisms operate branch circuit breakers. A heavy garlock packing is provided between flanges of box and front. It is arranged to seal the opening with help of heavy swing bolts and clamps. Conduit hubs for main and branch circuit cables are seam-welded to top or bottom of enclosure as desired. They incorporate thermal-magnetic, quick-make, quick-break circuit breakers for ac and dc service. Lugs only or main circuit breaker construction is available. Branch circuit breakers are provided in ratings from 15 to 50 amp, single pole, and 15 to 100 amp, 2 pole and 3 pole.

Square D Company, 6060 Rivard St., Detroit 11, Mich.

Ballast (8)

A new enclosed clamped core ballast which has no Underwriters' "suitability of enclosure" limitations has been announced. Designed specifically for use on small fluorescent fixtures with 14-, 15-, and 20-watt fluorescent lamps, it also can be applied to signs where encased, compounded units have been used previously. Each enclosed clamped-core ballast is equipped with a universal mounting clamp with mounting ears on both side and bottom to allow installation at most convenient place in fixture. Slot-shaped holes are provided to give a wide choice in location of fixture mounting holes. It operates on 110/112 volts, 60 cycles. Bulletin GEA-6040 available.

General Electric Co., Schenectady 5, N. Y.



Recessed Lighting Unit (9)

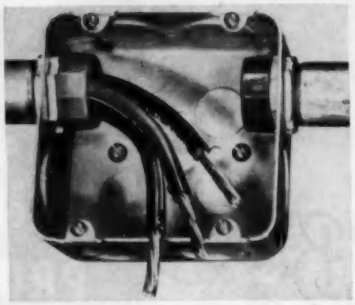
A new recessed lighting unit, known as Ecco, was designed to make a recessed fixture available to builders of inexpensive tract homes. Features include built-in junction box, specular reflector, lens of Alba-Lite glass, and a chrome finish frame hinged for easy relamping. Designed to be installed with Marco bar hangers, fixture can be installed in 30 seconds.

Marvin Manufacturing Co., 1150 So. Beverly Drive, Los Angeles 35, Calif.

Lighting Fixtures (10)

A new line of lighting fixtures for gymnasium, auditoriums, drill halls and other high bay areas. Model illustrated is pendant type which is available in two sizes, one for R-40, the other for R-52 projector flood lamps, 150 to 750 watts. Similar units are also available for flush or surface mounting. All types are equipped with hinged cast aluminum louvered guards. Snap-in type rubber-roller latch simplifies opening and closing guard during relamping operation, which is accomplished from the floor through the use of vacuum or clamp type lamp changer. Bulletin No. 137-53 is available.

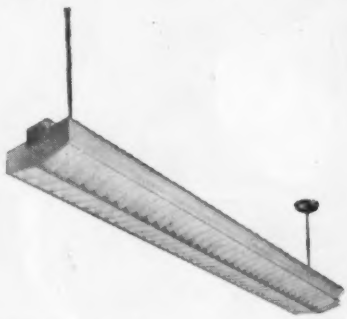
Steber Manufacturing Co., Broadview, Ill.



Insulating Bushing (11)

Development of a shatter-proof insulating bushing for ½ to 6-inch standard rigid electrical conduit has been announced. Made from a special cellulose acetate butyrate formula, the new bushing is tough and resilient. Underwriters' Laboratories has approved the bushing, which is designed to conform to latest requirements of National Electrical Code. The code specifies positive protection against damage to electrical wiring at ends of raceways to prevent short circuits and fires. Additional features include a fold-back throat, dual-purpose threads, ease of handling and bright blue coloring.

Thomas & Betts Company, Elizabeth, N. J.



Lighting Unit (12)

A new fluorescent lighting unit, called The Cavalier, features full length luminous side panels with no opaque metal framing. Side panels are supported internally by a steel frame. A low brightness finish is used on louvers, side reflectors and channels. The plastic side panel is gauged to 100 foot lamberts. Unit is available in either four or eight foot lengths equipped with rapid or instant start lamps. Features include an adjustable ceiling strap which adjusts for either out-of-line or in-line error in location of mounting points; a hook on stem assembly for mounting; and a sliding stem plate within channel which can be moved from end to end of unit to provide mounting in any desirable point. Unit may be mounted on-surface, on 5-inch stem and canopies, on 20-inch stem and canopies, or for individual mounting on a twin stem canopy assembly. Louvers are lowered by means of press buttons and are supported by safety chains when lowered.

F. W. Wakefield Brass Company, Vermilion, Ohio.

"Buffalo" FANS

NEW

Efficient, Easily Installed PROPELLER FANS for Factory Ventilation!

Heavy Duty 54" Design 65 "NV" Disk Fan

New NV-BREEZO Line In Size Range Up To 84 Inches, Or 90,000 CFM

These new, larger "Buffalo" Package Units are specifically designed to solve practically any factory ventilating problem. Often, they can handle jobs that formerly called for much more expensive units. And, they provide steady performance with minimum power pull, either on free air delivery or against pressures of up to 1". Special models for high temperature and/or corrosive fume applications.

Direct or V-belt types available, in sizes from 24" to 84", or from 4,000 to 90,000 CFM. They're huskily built in the "Buffalo" tradition for long-run performance with practically no maintenance. Get FULL DETAILS TODAY on this new line of "Buffalo" Breezo Fans. You can cash in on sizeable profits by recommending them. Write now.

Send NOW for Complete Data on New "Buffalo" "NV" Propeller Fans

BUFFALO FORGE COMPANY

520 Broadway Buffalo, New York

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
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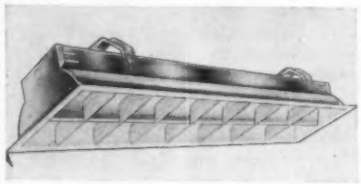
PANEL BREEZO FANS
BREEZ-AIR ATTIC FANS
BELTED VENT SETS
"L" BREEZO FANS
BELT-AIR FANS
"NV" BREEZO FANS

Air Cleaner (13)

A new ceiling-suspended model of the home Precipitron electrostatic air cleaner. The average-sized home model, PH-122, is designed for installation in the main return air duct of a forced-air heating system. It weighs 200 pounds and handles from 1000 to 2000 cubic feet of air per minute. For larger homes, a slightly larger model, PH-242 is available, which handles from 2000 to 2400 cubic feet of air per minute. Both units clean recirculated air from living quarters as well as "make-up" air from outside. Water and drain line connections for washing away accumulated dirt are provided on both units. They operate on any ac, 115-volt line.

Westinghouse Electric Corp., Air Conditioning Div., Dept. T. 556, 200 Readville St., Hyde Park, Boston 36, Mass.



Troffer (14)

New Para-Louvers have been developed for use with all Day-Brite Alzak aluminum parabolic troffers. Para-Louvers have lowered the lengthwise brightness to approximately .6 candles per square inch. Aluminum parabolic troffers can now be installed at any angle with a guarantee of comfort. Troffers are available in two-lamp 40-watt rapid start, flange or snap-in types. Para-Louver assembly snaps to wireway cover. Literature available.

Day-Brite Lighting, Inc., 5411 Bulwer Ave., St. Louis 7, Mo.

Incandescent Bulb (15)

Reduction in the size and improvement in the performance of the 200-watt incandescent light bulb were announced. The new size is expected to find limited but increasing use in residential lighting, and to permit commercial and industrial consumers to increase the light output from fixtures now using 150-watt bulbs. The new lamp is more than an inch shorter, and five-eighths of an inch smaller in diameter, than existing 200-watt bulbs.

New features of bulb are a coiled-coil filament, and a heat-reflecting disk which serves to hold down the operating temperature of the base in all types of sockets.

General Electric's Lamp Division, Nela Park, Cleveland 12, Ohio.

Electric Radiant Heater (16)

A new type of electric radiant heater for industrial oven heating, such as baking, curing, drying, plasticizing and other heat processing where temperatures of 400° to 500° F are required. A single heating unit consists of a fused quartz tube, 48 inches long, in which is encased a heavy duty nickel-alloy heating element. Each heating element has an individual stainless steel reflector. Radiant heater panels and assemblies are made up from multiples of these units. Capacities of individual units range from 100 to 1000 watts per linear foot. Heaters are available in single units or multiple sections with various panel arrangements for complete oven assemblies.

Cleveland Process Co., 1965 East 57th St., Cleveland 3, Ohio

Magnet Wire (17)

A new line of magnet wire in a wide range of sizes, for class H service or better, has been announced. Insulated with Teflon, the wire has a low loss factor, low dielectric constant and excellent dielectric strength. Characteristics remain stable at temperatures from minus 100°C up to plus 260°C. Insulation is nonflammable, inert to moisture and all known commercial solvents and chemicals. The solid conductor may be either soft or annealed copper, on which the Teflon enamel is dip-coated. Sizes range from 14-50 AWG, in six colors. Single, heavy, triple or quad thicknesses are available. Applications include: motors, generators, alternators, and convertors; transformers, relays and solenoids; delay lines, chokes and filters. Literature is available.

Hitemp Wires Inc., 26 Windsor Rd., Mineola, L. I., N. Y.

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WIRE STRIPPERS

Save Minutes and Money ON EVERY STRIPPING JOB

Stripmaster®

Patented, No. 2,523,936

with Exclusive "ONE-SQUEEZE" Action for 2-second Stripping of Lighter Gauge Wire . . . Handles Heavier Gauges, Too

A light squeeze on the handles strips wire up to a full 7/8" clean and bare. Comfortable grip fits small hand, tool weighs only 10 oz. Exclusive automatic lock holds jaws open after stripping until wire is removed, prevents crushing stranded wire. Won't nick or score wire. Cutter ends are shielded for complete safety. Specially hardened stripping blades may be easily replaced or interchanged.

SIX MODELS for all wire sizes from No. 8 to No. 22. Also for POSJ.

RUGGED, ALL-STEEL

"E-Z Automatic" Model

For Heavy Duty Stripping

Works like pliers, to make tough stripping jobs fast and easy. Powerful leverage enables you to easily cut through tough insulation and then strip wire bare. Automatic stop locks blades and jaws, preventing back-snap against wire ends. Cannot crush stranded wire or accidentally nick or score wire. Cutter edges shielded to safeguard hands. Can also be used as a *wire cutter.*

Specially hardened blades are replaceable. Models for all wire sizes from No. 10 to No. 26, also for POSJ, 300 ohm TV Downlead and non-metallic plastic sheathed cable.

Sold Through America's Leading Distributors

FREE CATALOG INFORMATION

IDEAL INDUSTRIES, Inc.
1041 Park Avenue, Sycamore, Illinois

Please send me catalog data on "Stripmaster" and "E-Z Automatic" Wire Strippers.

Name_____

Company_____

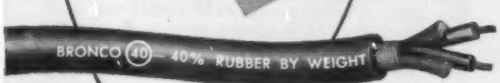
Address_____

City_____ Zone____ State_____

BRONCO 40

always tops in its class...

now jacketed with 40% RUBBER BY WEIGHT and is so branded!

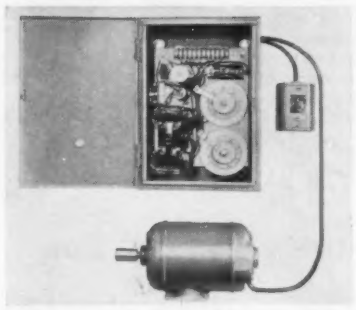


The only 40% rubber-jacketed portable cord with branded jacket. And it is self-measuring, too—branding is repeated every two feet!

BRONCO 40 is recommended for inside, non-oily locations. Where severe conditions are encountered and maximum protection is required, the cord and cable to specify is **BRONCO 60** *CERTIFIED* with 60% by weight *Neoprene* branded jacket.

SOLD NATIONALLY BY ELECTRICAL WHOLESALE DISTRIBUTORS

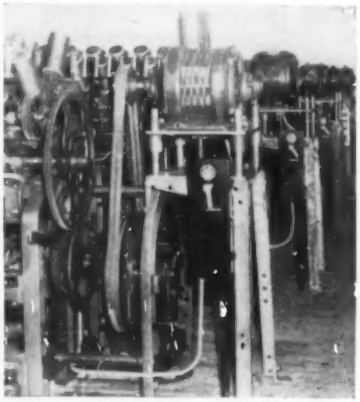
Manufactured by WESTERN INSULATED WIRE CO., Los Angeles 58 • California



Motor Drive **(18)**

Bulletin 6520 Vari-Amp magnetic amplifier motor drive is a self-contained unit, which will provide adjustable motor speeds from ac power. It converts ac power from a 115 volt, 60 cycle source to dc power which is used to drive a dc motor. Speed is continuously adjustable over the complete range by means of a small rheostat located on control station. Standard unit will provide for a speed range of 10 to 1 and is available with motors ranging in size from 1/40 hp up to and including ½ hp. Unit consists of three components: main control panel, control station, and motor. Basic unit is provided with an on-off switch and speed adjusting rheostat on control station. Optional features include jogging, dynamic braking and reversing.

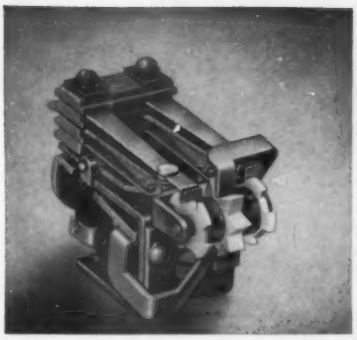
Clark Controller Co., 1146 East 152d St., Cleveland 10, Ohio.



Motor Base **(19)**

Six-inch vertical adjustment is provided by the LMV motor base. In addition to saving floor space and machine frame, it provides the great amount of adjustment required where driving wheels are changed that operate with endless belts or chains. Vertical motion is also great enough for use with vari-pitch sheaves with 3:1 variation. All-steel base shown accommodates electric motor frame 284, which can be either 7½ hp at 1800 rpm, 5 hp at 1200 rpm or 3 hp at 900 rpm. Center adjusting screw can be shortened where full 6-inch movement is not required.

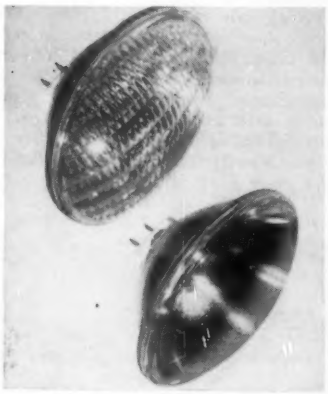
Quintin James Kearney, 220 Congress Ave., Lansdowne, Pa.



Sequence Relay (20)

A midget sequence relay with a variety of DP-ST and DP-DT contact arrangements, known as Frame 211. A double cam movement permits contacts to be adjusted to operate when coil is de-energized. Cam rotates a half step when coil is energized, and completes step when de-energized. Contacts may be set to open, close, or transfer in any desired sequence, providing the number of steps in a complete cycle is divisible into six or eight. All commonly used continuous-duty coils in ratings up to 115 volts dc, or 230 volts ac, can be supplied. Power consumption is 5 to 6 watts dc, or 10 to 12 volt-amperes ac. Contacts are rated at 5 amps ac; or 0.5 amps dc at 115 volts; and 5 amps dc at 24 volts. Bulletin No. 5211 is available.

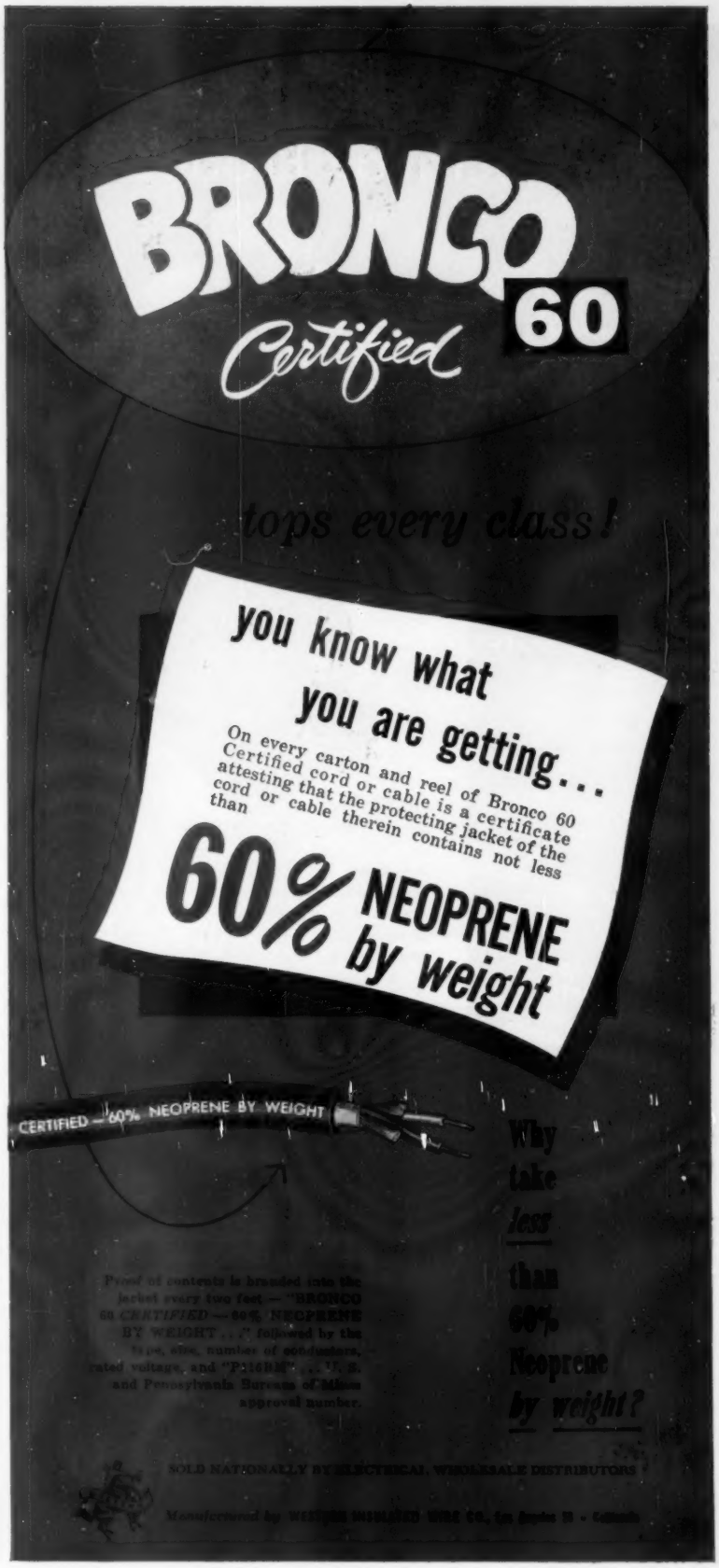
Struthers-Dunn, Inc., 150 North 13th St., Philadelphia 7, Pa.



Reflector Lamps (21)

Narrow and wide beam 300-watt reflector lamps with a PAR-56 bulb shape are available. Lamps may be used at 115, 120, or 125 volts and may be burned in any position. Designed for a wide range of applications, they may be used in combination or singly. The base is a mogul end prong type, to be used for the purpose of electrical connection only and not for supporting the lamp. Made of heat-resisting glass, bulb may break on contact with water. Therefore, it should be used with equipment which protects it from weather. Equipment should be so designed that operating temperature of plug wiring does not exceed 200°C.

Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J.


BRONCO 60
Certified
tops every class!
you know what you are getting...
On every carton and reel of Bronco 60 Certified cord or cable is a certificate attesting that the protecting jacket of the cord or cable therein contains not less than
60% NEOPRENE by weight
CERTIFIED — 60% NEOPRENE BY WEIGHT
Why take less than 60% Neoprene by weight?
SOLD NATIONALLY BY ELECTRICAL WHOLESALE DISTRIBUTORS

FULLMAN **Latrobe**
Electrical Products

Floor Boxes and Wiring Specialties

ADJUSTABLE WATERTIGHT FLOOR BOXES

NON-ADJUSTABLE WATERTIGHT FLOOR BOXES

ADJUSTABLE GANG FLOOR BOXES 1-2-3 AND 4

NOZZLES AND FLOOR BOX ACCESSORIES

FLOOR JUNCTION BOXES

UTILITY OUTLETS

INSULATOR SUPPORTS

PIPE AND CONDUIT HANGERS

ARMORED CABLE SUPPORTS

CABLE CLIPS

STAPLES

FISH WIRE

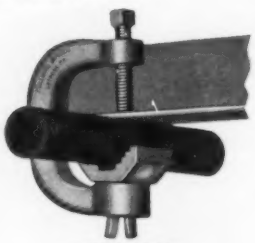
FULLMAN MANUFACTURING CO. QUALITY AT LATROBE OB SUPREMACY LATROBE PA.

"Latrobe" Floor Boxes and Wiring Specialties are top performers because they are expertly designed of the finest materials.

"Latrobe" Products are proof that the shortest road to efficiency and economy lies through quality.

ADJUSTABLE—WATERTIGHT FLOOR BOXES

Adjustable Floor Boxes are now bonded which makes them fire-proof—come in single round or square bodies—also furnished in square single gang, two gang, three gang and four gang types.



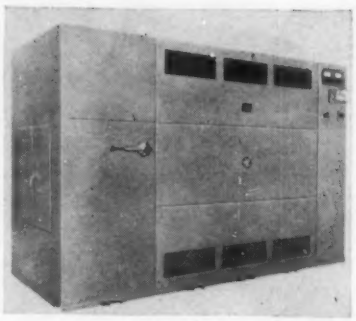
"BULL DOG" PIPE OR CONDUIT HANGER

This sure grip Bull Dog hanger is economical and dependable. Hangs pipe or conduit ½", ¾", and 1" to steel beams ⅜" thick.

Fullman Manufacturing Co.

1209-1215 JEFFERSON STREET

LATROBE, PA.



Transformer (22)

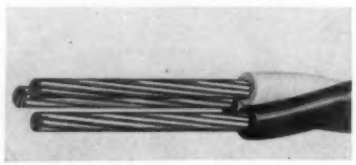
A new 2000 kva transformer—unit load center features built-in automatic forced draft equipment to increase capacity under overload conditions. It is rated: primary 4800, 60 cycles, 3 phase; secondary 480 volts. Unit is packaged complete with fused load break air switch on primary, and secondary metering and pull section —primary switch handle and access door interlocked for safety. It features class B hi-dielectric, hi-heat magnet wire insulated with Johns Manville Quinterra and Dupont's miracle "Mylar" polyester film.

Marcus Transformer Co., 32-34 Montgomery St., Hillside 5, N. J.

Pushbutton (23)

A new No. 25700 narrow pushbutton, 2½-in. long and ¾-in. wide, in an air flow design to blend with contemporary or period style front door hardware for narrow door jambs. Available in polished brass, sprayed brass, old iron or polished chrome finishes. Plates are of stamped solid brass with black plastic buttons, water resistant composition backs and copper alloy contacts.

Trine Manufacturing Corp., 1430 Ferris Place, New York 61 N. Y.



Remote-Control Wire (24)

A new Flamenol indoor remote-control wire offers visual circuit identification, color-coded the same as the leads on G-E remote-control devices. It has a twisted construction. Wire is designed for indoor use on low-voltage remote-control wiring systems, low-voltage thermostatic control circuits, and bell wiring. It is available in 2- and 3-conductor construction and has a rating of 30 volts maximum. Color-coding for 2-conductor wire is black and white; for 3-conductor, black, white and red. Individual conductors are of 7-strand copper wire for flexibility and No. 20 AWG in size.

General Electric Co., Bridgeport 2, Conn.

Skylike SOLVES A LIGHTING PROBLEM

at the

SHERATON CADILLAC

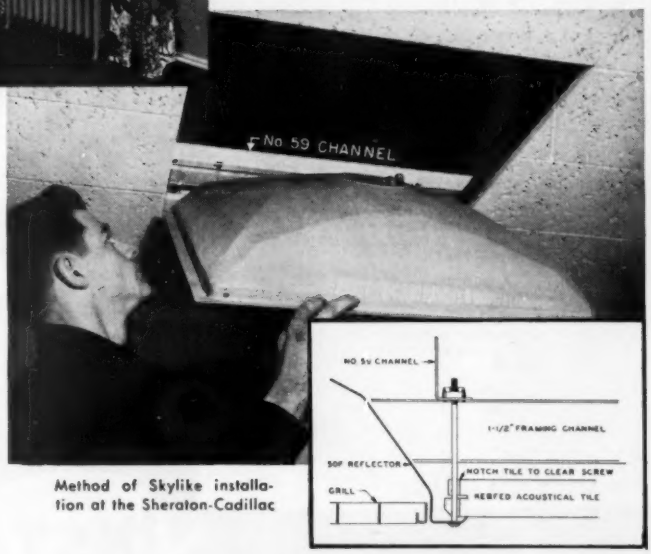
Bedroom suite at the Sheraton-Cadillac using Skylike units

THE PROBLEM . . .

Major renovations of this famous hotel involved air conditioning for the guest rooms. To complete the modernization acoustical ceilings were installed. Hotel management wanted recessed lighting units which would harmonize with any decorative scheme and provide comfortable well diffused illumination.

THE SOLUTION . . .

Recessed SKYLIKE incandescent units using 200W lamps were chosen and installed in the new hung ceiling construction. Sheraton-Cadillac engineers developed a special mounting device for the reflectors which would allow them to be supported from the ceiling framing members without need of bolts or other fastening devices. This permitted adjustment and alignment of fixtures after acoustical panels were installed. (See insert)



Method of Skylike installation at the Sheraton-Cadillac

Skylike . . .

This modern, versatile unit can solve your lighting problems as successfully as it has in countless installations throughout the country in . . .

DEPARTMENT STORES
RETAIL STORES
OFFICE BUILDINGS
THEATRES
HOUSING DEVELOPMENTS
BANKS
SCHOOLS, ETC.

SKYLIKE
A SILVRAY-ASSOCIATED COMPANY

SEND FOR COMPLETE DETAILS

A comprehensive 8-page booklet describing the SKYLIKE system and its simple installation is yours for the asking. To get your free copy, fill in and mail the coupon below.

SILVRAY Lighting, Inc., 101 West Main St., Bound Brook, N. J.
Gentlemen:

Please send me complete information on Silvray **SKYLIKE**

Name_____

Firm_____ Title_____

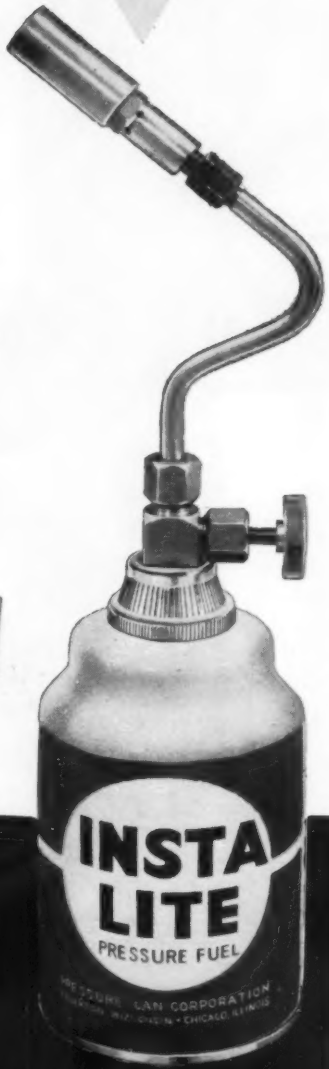
Address_____

City_____ Zone_____ State_____

INTRODUCING
the new INSTA-LITE torch!

The new INSTA-LITE Torch with inexpensive throw-away cartridges is designed for safety first—there's no pouring . . . therefore no spilling! No pumping! No priming! Just turn the valve and light!

The light-weight INSTA-LITE Torch operates with self-pressurizing, highly volatile, INSTA-LITE LP fuel. Each fuel cartridge contains 8500 B.T.U. — gives hours of clean, odorless, pencil-point flame . . . at a temperature of more than 2000° F.



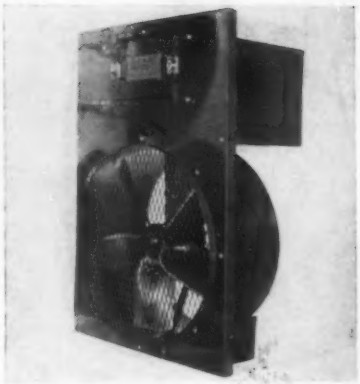
The INSTA-LITE Torch is easy to handle (torch and cartridge weigh less than 1½ lbs.), easy to change . . . just insert torch and give half-turn! Burns steady, automatic flame until fuel is entirely gone.

A concentrated national advertising campaign, in leading consumer magazines, designed to create buyer demand. FREE newspaper mats available on request.

WRITE FOR DETAILS

THE INSTA-LITE TORCH IS AN IDEAL TOOL FOR COUNTLESS SHOP CONSTRUCTION, AND HOUSEHOLD ELECTRICAL JOBS.

PRESSURE CAN CORPORATION
EDGERTON • WISCONSIN



Exhaust Fan (25)

A new and improved wall or window mounted sheet metal exhaust fan. The unit is primarily designed for installation in areas where it is necessary to exhaust hazardous fumes, such as, paint overspray and engine block cleaning equipment. The window mounted unit is installed in an existing window or concrete block wall. Motor is accessible for inspection and maintenance from inside the room by an access door. Motor is protected from elements of weather by a protective sheet metal cover on exterior of building. Literature is available.

M & E Manufacturing Co., 2531 Winthrop Ave., Indianapolis 5, Ind.

Cable Reel Handling (26)

Cable reel hand truck has a structural frame with tubular push bar construction. Operator places hooks under reel's center bar by tilting truck forward. It has an adjustable trunion so that various diameter reels may be handled. Two casters and two main wheels assure easy maneuvering. There is a foot-operated brake to lock unit in position when unreeling cable. Unit is ideal for transporting cable reels to point of use and unwinding them on the spot by one man.

Lewis-Shepard, Watertown, Mass.

Appliance Load Ratings (27)

New 1954 appliance line specifications announced by the General Electric Co. include the following electrical connections and loads:

Automatic dishwasher, Model SU-60—an outlet box is mounted on bottom rear

cross channel of the cabinet—takes an individual 20 amp circuit. Connected load is 1375 watts.

Electric sinks, SE-60 and SE-40—take an individual 20 amp circuit to the receptacle box mounted on the back of the sink. For Disposall run a cable connection from the receptacle box to the control switch housing.

Disposal 1 FA-4, and FA-45—6.5 amp average load. FC 20—4.6 amp average load.

Upright food freezer—HU-15L, ¼ hp unit.

Liberator deluxe automatic range, Model J-408—max. connected load 15.8 kw.

Stratoliner deluxe automatic range, Model J-402—max. connected load 12 kw.

Mainliner automatic range, Model J-406—max. connected load 15.8 kw.

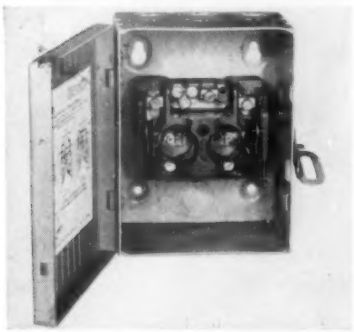
Speedster automatic range, Model J-401—max. connected load 11.2 kw.

Spacemaker range, Model J-363—max. connected load 11.3 kw.

Window air conditions, R-72 1 hp—1720 watts; R53 and R52 ¾ hp—1220 watts; R-32 1 hp—965 watts; R-20 ½ hp—700 watts; R32 and R20 available for 115-volt service; R72 for 208-230 volts; R53 (reverse cycle) for 230 volts; R52 for 115-208-230 volts.

Clothes dryer model DA621L—on 115-volt operation unit takes 1400 watts, on conventional 230-volt, 3-wire operation unit takes 4700 watts. A terminal block is provided, a special 230-volt cord-set may be obtained.

General Electric Company, 310 West Liberty St., Louisville 2, Ky.



Switch **(28)**

A new 30-amp side operated general purpose safety switch. Companion to the front operated and raintight switches, it has the strong rotor blade construction which allows for cool operation and double break on each pole. Specially designed built-in arc-snuffers instantly divide and extinguish arc. Switches are available in both two- and three-wire with plug or cartridge fuse. They are suitable for use as service entrance equipment and are designed to protect light machinery. Features include generous wiring room, conveniently located knockouts, solderless connectors on line terminals, and baked-on Melamine finish.

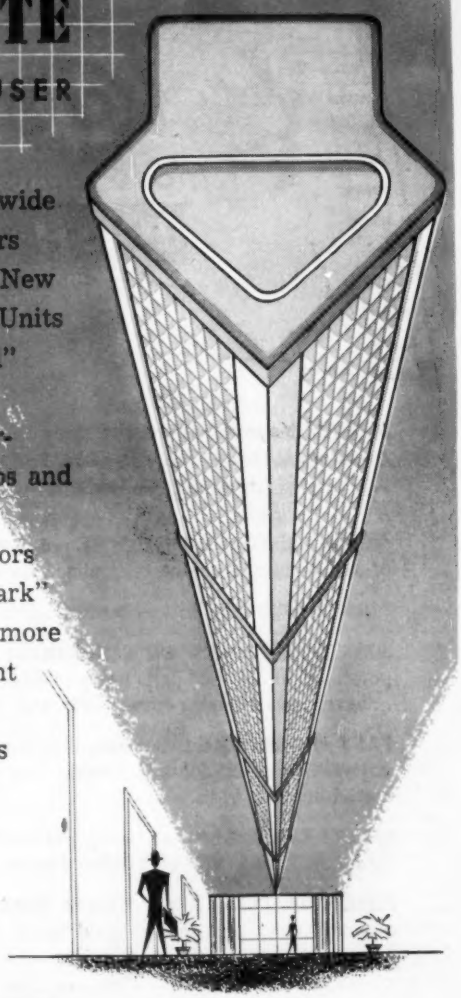
Murray Manufacturing Corp., 1250 Atlantic Ave., Brooklyn 16, N. Y.

make hallways say, "Come in!"

new Guth V·C·U

"V" CORRIDOR UNIT

with GRATELITE* LOUVER-DIFFUSER



At last—you can fill wide hallways and corridors with practical light! New Guth "V" Corridor Units provide "wall-to-wall" illumination. The GRATELITE Louver-Diffuser shields lamps and is easily maintained. Hallways and corridors "come out of the dark" and turn into safer, more cheerful lines of light that guide the eyes and the step. V·C·U's available in 4′ & 8′, 1 & 2 light models.

*Patents Pending
Trademark Registered

Write today on your letterhead for complete information.

Guth

THE EDWIN F. GUTH CO. ST. LOUIS 3, MO.

NOW! Keynote opens the door to real push button value. Excellent in design. Low in price. Enduring and dependable . . with the outstanding, famous quality of all Edwards products.

GOOD DESIGN! Smart classic simplicity that complements all types of architecture. Slim and streamlined for narrow door trims.

PIANO ACTION! Instant positive contact at feather touch.

NEVER TARNISHES OR CORRODES! Lifetime finish needs no polishing. All exposed parts heavy plastic . . always in working order . . never rusts or stains outside of house.

EASY MOUNTING! Convenient surface mounting . . with just two screws. Covers old doorbell opening. Not necessary to drill or ream special hole for wires.

SMART COLORS! Brown, ivory, chrome*, brass*, with contrasting push-key. Blends with all exterior finishes.

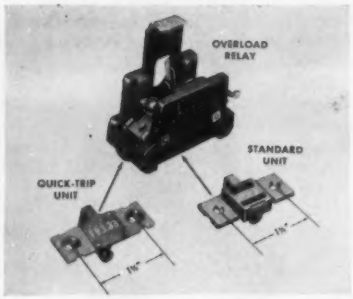
FINE QUALITY . . LOW COST! Outstanding push button in the economy class. Exceptional good looks. Finest performance. Just 26¢ to 52¢ each, depending on color.

*Edwards special 'Vaculized' finish gives the lustrous beauty of polished brass or chrome.

ASK YOUR ELECTRICAL SUPPLIER ABOUT KEYNOTE!

EDWARDS

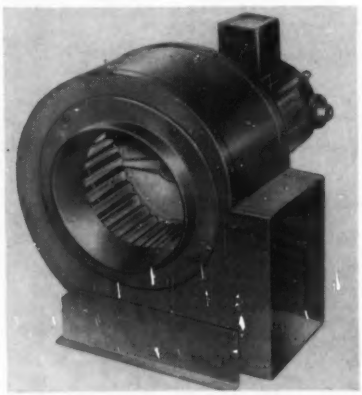
EDWARDS COMPANY, INC., NORWALK, CONN.
In Canada: Edwards of Canada, Ltd.



Thermal Unit (29)

A new quick-trip overload thermal unit for protecting hermetically sealed compressor motors. Shown with the overload relay is Type FB quick-trip unit (lower left) which trips in approximately one-third the time required by Type B standard unit (lower right). Another feature is interchangeability. Thermal element used is a separate factory calibrated unit and is not an integral part of overload relay block. Starters and unified control panels can be stocked without thermal units, minimizing inventory. When starter or control panel is installed, correct thermal unit to match compressor size can be assembled from front.

Square D Company, 4041 N. Richards St., Milwaukee 12, Wis.



Blower (30)

A large-capacity blower, 6-inch wheel, for quick removal of fumes, smoke, and stale air, or for cooling and ventilating. Moving up to 600 cubic feet of air per minute, the blower features an automatic cutout which stops the completely enclosed 110-volt, 60 cycle motor before it can overheat.

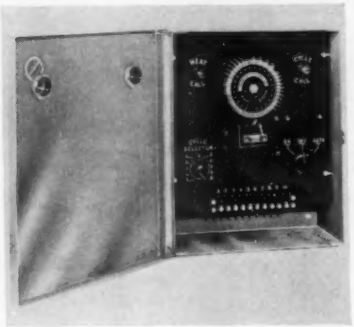
Standard Electric Mfg. Co., Inc., West Berlin 12, N. J.

Exit Light (31)

A new line of hinged exit units features a housing that may be surface mounted or recessed, as desired. Two frames fit the same housing—one for surface, the other for recessed installations. Marco plaster bars provide a quick method for installing housing in all types of wall

construction. Five knockouts permit wiring access from all directions. Six-inch high letters are finished in gray hammertone and backed by green glass. Interior is of white enamel for reflection of light provided by two 25-watt lamps. Exit frame snaps on, and spring tension locks hold it in place, permitting easy relamping or maintenance. They are approved by Underwriters Laboratories.

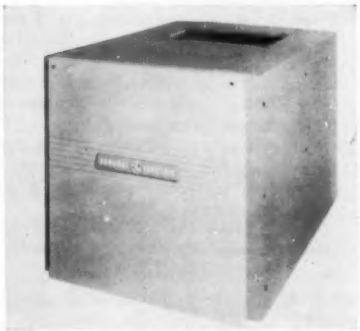
Marvin Manufacturing Co., 3071 East 12th Street, Los Angeles 23, Calif.



Heating Control (32)

A new automatic heating control, called "Tork Weather Control", is a combination of an inside control panel and an outside weather head, and automatically regulates the heating of any building. It times heat to the weather and synchronizes heat output to the actual demands of the weather. Heat is cycled on the inside control panel according to outdoor temperature and indoor building satisfaction; weather control starts and stops heating plant at pre-selected intervals as programmed on the 24-hour dial. For summer use, the "Off" position allows the system to provide hot water, without heating building. Unit is available in 115-volt 60-cycle and 208-230-volt 60 cycle models.

Tork Clock Company, Inc., Mount Vernon, N. Y.



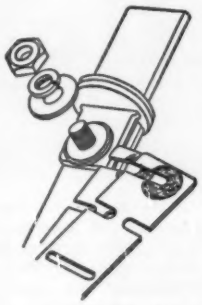
Cooling Equipment (33)

Air-cooled units that cool an entire house without using water, and space-saving downflow and horizontal models designed for use in basementless houses highlight G-E's 1954 line of home cooling equipment. The addition of a 1½-ton unit for installation in smaller houses and new

THE ELECTRICIAN WITH INSIDE KNOWLEDGE SPECIFIES

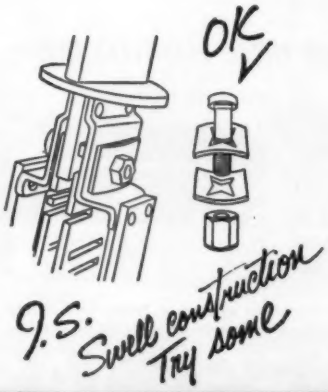
WARE HI-LAG FUSES

There is a great scientific and practical difference in renewable link fuses. WARE Hi-Lag FUSE superiority is winning happy new users... lowering plant maintenance costs... and winning more sales and good-will for the men who recommend them.



Men Who Know
STUDY FUSE PROBLEMS

When current flow is distributed over the extra wide end surfaces of WARE Hi-Lag links, the full current carrying capacity of the links is used. The widths of the knife blades and links match each other. Current is not converged into hot pressure spots as in old fuse designs which secures links against knife blades with pressure from a small diameter washer. With WARE Hi-Lag the entire end surface of the link is gripped in never loosening contact with the knife blade by means of an exclusive bridge assembly and extra wide spring-tension washers.



Men Who Know
STOP NEEDLESS BLOWS

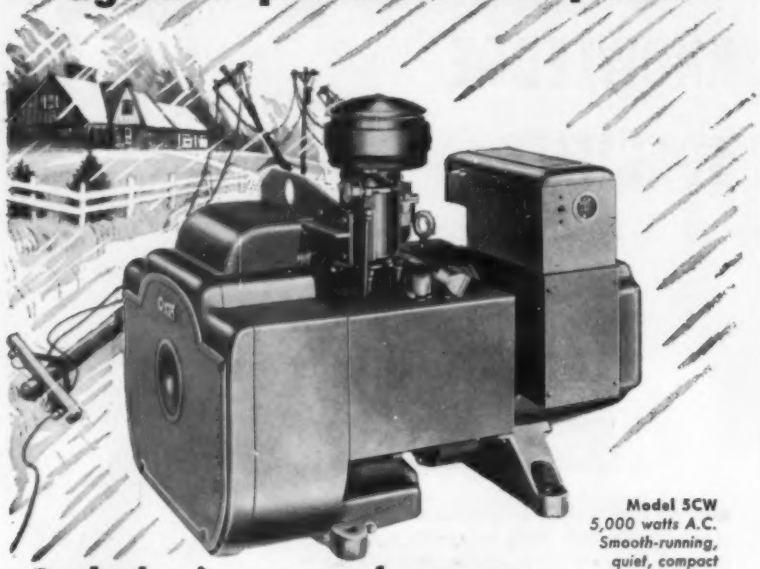
Sure! Fuses are supposed to blow to give adequate protection, but poorly designed fuses blow long before they should! Link contact points in other fuses loosen and oxidation results due to expansion and contraction of metals and fibre during OFF and ON periods and cause excessive heating and unnecessary blows. Not only does exclusive WARE Hi-Lag design cut the number of dangerous contact points in half, but loose link contacts CANNOT HAPPEN in a WARE Hi-Lag! Large spring tension washers hold the link and knife blades in a solderless connection. The spring tension washer never loses tension . . . always locks the links safely into the circuit.

Write now for all the fuse facts
Ware Fuses Guaranteed to Meet the Severest Test
UNDERWRITERS APPROVED

Ware Fuse CORPORATION

4410 WEST LAKE STREET
CHICAGO 24, ILLINOIS

Specify built-in protection against power interruptions



Model 5CW
5,000 watts A.C.
Smooth-running, quiet, compact

Include, in your plans, an ONAN *Emergency* Electric Plant

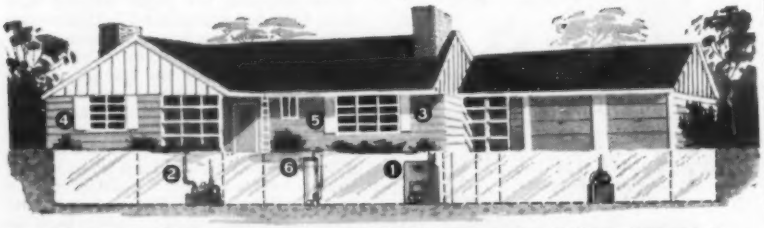
The homes you help build become unlivable and even unsafe when storms, floods or other disasters interrupt electric power.

Suburban homes are especially vulnerable because of their complete dependence upon electricity. When power interruptions occur, these homes are without heat, water, refrigeration and lights. Freezeups and food spoilage can cause severe losses; fire hazards are increased.

A low-cost Onan Emergency Electric Plant is insurance against power interruptions. When they do occur, the Onan plant supplies regular 115-volt A.C. electricity for all essential uses as long as the emergency exists. Automatic controls start the Onan unit when power fails and stop it when power is restored, protecting the home at night or when the family is away.

Very little space is required for installation in basement or garage. Hook-up to the wiring system is simple. Write today for information on dealership and folder describing Onan Standby Electric Plants . . . gasoline-driven, 1,000 to 50,000 watts A.C.

PROVIDES ELECTRIC POWER FOR THESE ESSENTIAL USES—



1. Automatic oil, gas or coal furnaces. 2. Electric water system. 3. Home freezer and refrigerator. 4. Lights, radio, etc. 5. Electric range (limited use). 6. Water heater.

Write for Standby Power Folder

D. W. ONAN & SONS INC.

Onan ELECTRIC PLANTS

8302 University Ave. S.E. • Minneapolis 14, Minnesota

and improved upflow models for houses with basements completes the line.

The downflow cooling unit was designed primarily for houses that are on slab foundations. Available in four sizes, including 1½-ton, 2-ton, 2½-ton and 3-ton capacities. The horizontal cooling units are designed primarily for houses with crawl space or large attics. It may be suspended from ceiling in utility room and basement, or tucked away in attic. It comes in the same four sizes as the downflow models.

The upflow line used in houses with basements has added a 1½-ton size to the line. This line now consists of five sizes—1½-, 2-, 2½-, 3-, and 5-ton. All upflow units are similar in design and appearance. They are self-contained package units housed in a two-tone gray cabinet. They are designed to integrate with upflow furnaces for year-round air conditioning.

Cable Puller (34)

A new "Powered" cable puller for conduit jobs. Machine is portable and can be operated in any position for either pushing or pulling purposes. It pushes 25 feet of fish tape per minute around five 90° bends, stopping automatically if conduit is obstructed, or it pulls 15 feet of wire per minute into ¾-in. to 2-in. conduit. Machine provides 175 feet of 0.60-in. by ¼-in. usable tape. It operates on 115-volt ac or dc current and pulls 1200 lbs. dead weight. Machine is attached to conduit by means of brackets; supports hold machine in either vertical, horizontal or angle positions.

Barth Corporation, 12650 Brookpark Road, Cleveland 29, Ohio

Air Conditioners (35)

The 1954 line of Admiral room air conditioners features 13 models in ½-, ½-, ¾- and 1-ton sizes. Some are dual-purpose units that also can heat any room they can cool, with the adjustment of one control. They can be installed in conventional as well as casement windows, or through the wall. The new models

Stab-lok WILL HELP YOU SELL BUILDERS

because it has TOP acceptance

STAB-LOK® CIRCUIT BREAKERS give you all the winning arguments when you talk with builders. First of all, it's been proved that modern circuit protection is a real sales feature with prospective home buyers, and Stab-lok provides this at almost no extra cost. In the next place, there's no question about Stab-lok dependability. More Stab-loks are sold today than all other circuit breakers combined... they're on the job in literally millions of homes.

In addition, only Stab-lok gives you these extra advantages:

Lowest cost—Across-the-board, Stab-lok costs less in the first place; costs less to install; costs less when circuits are changed or added.

Most complete line—You can't find a sensible specification for circuit breaker protection that Stab-lok can't meet with speed and ease.

Most flexible—Stab-lok Magic "E", sequenced bussing, standard NA and space-saver NC breakers provide unheard-of flexibility.

Most distributors—Stab-lok distribution is unequalled; breakers and enclosures are available for prompt delivery the country over.

Builders are the biggest prospects for Stab-lok sales in your vicinity. Make the most of this opportunity... and write for the Magic "E" booklet which gives all the latest Stab-lok facts. Federal Electric Products Company, 50 Paris Street, Newark 5, New Jersey.

Federal NOARK

FEDERAL & PACIFIC

ELECTRIC PRODUCTS COMPANY — ELECTRIC MANUFACTURING CORP.

Federal products: Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct—**Pacific Electric products:** High voltage circuit breakers and power switches ★ **Sales offices in principal cities.**

MOST TROUBLE-FREE PROTECTION YOU COULD INSTALL!

HOT AIR

COLD AIR

Pierce Fuses Operate 10 to 40% Cooler!

Unique screened venting permits air to circulate freely through Pierce Fuses. This allows free escape of excess heat — prevents rapid charring and deterioration of the fuse case, as in ordinary fuse construction.

Pierce Fuse Cases Last 6 to 8 Times Longer!

Yes, this venting actually makes Pierce Fuse cases last 6 to 8 times longer! No wonder these time-proved, renewable fuses are so popular!

No Unnecessary Blows!

Pierce Screened venting and balanced lag links prevent wasted links during safe overloads.

No More Danger of Afterblows

Since dangerous gases and heat have free escape, Pierce Fuses are your insurance against afterblows.

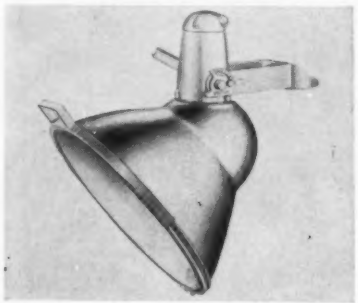
(Also a complete line of quality non-renewable fuses.)

WRITE TODAY for this factual bulletin. Start now to enjoy Pierce benefits.

PIERCE RENEWABLE FUSES, INC.
LEICESTER NEW YORK

are of "hideaway" design extending only three inches into the room and permitting draperies to be drawn over them. Clear-view polystyrene side panels on both sides of the unit are used to admit additional light when installed. They have 18 different dial settings. In addition to cooling or heating, they dehumidify, ventilate, filter and remove stale air.

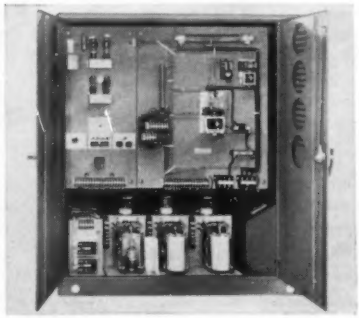
Admiral Corporation, 3800 Cortland St., Chicago 47, Ill.



Floodlight (36)

A new and improved "Series 4000" floodlight designed for all sports and industrial area lighting. These units feature a new thermal shock and impact resistant lens mounted in a combination slide-on and hinged lens ring with weatherproof gasket. Unit has a built-on service wrench, repositioning stop and indicator scales for easy setting. They are made of heavy gauge reflector grade sheet aluminum finished in either diffuse or specular Anodal. They are designed for PS-52, 750- to 1000-watt lamps and can also be supplied with special sockets to accommodate bi-post lamps. Bulletin No. 127-53 is available.

Steber Mfg. Co., Broadview, Ill.



Power Drive (37)

Development of a new mercury rectifier variable-voltage power drive, known as "Xatron V*S Drive", designed for a broad range of industrial applications requiring adjustable-speed service has been announced. The first size of air-cooled Xatron rectifier available, operating in a three-phase bridge arrangement, provides conversion suitable for 30, 40 and 50 hp drives. The V*S Drive with Xatrons consists of operator's control station; adjustable-speed drive motor; and control unit, which is enclosed in a cabinet

56⅝-in. wide, 65¾-in. high and 28-in. deep. Utilizing mercury arc rectification with a newly developed single anode mercury pool rectifier tube known as an "Xatron", it now gives industry way to convert ac to controlled dc variable voltage for application to adjustable-speed drive equipment.

Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland 10, Ohio.

Loom Switch (38)

A new loom switch, completely lint- and dust-tight and adaptable to loom, wall, or pedestal mounting, has been announced. Included in the new protective features of switch is a die-cast aluminum slide mechanism which is built into the cover to engage the toggle handle. Slide is sealed snugly by spring pressure against a moisture-, fungus-, and insect-proof cotton-felt gasket. A cork-neoprene gasket lines inside edge of cover to keep lint out. Resistant to moisture, abrasion, and many corrosive atmospheres, it is held in alignment by a Bakelite mounting plate. The switch, which can be inverted in the cover for top or bottom power feed, is held in the enclosure by four screws. Dimensions are about 5 by 4 by 9¾-in., and optional mounting pedestal measures 6 by 5⅜ by 4-in. Bulletin GEA-6001 available.

General Electric Co., Schenectady 5, N. Y.

Heating Units (39)

A new line of electric blower-type heating units available in industrial types for use in factories, console types for offices and stores, and furnace types for homes. The heat is distributed at floor level, with or without use of ducts, and is mixed with surrounding cooler air, gradually raising room or zone temperature to comfort requirements. Heaters may be suspended on the walls, hung from ceiling, or mounted on floor, either within the space to be heated or in close proximity. They may be used singly or in combination of multiple units. They may also be used as portable heaters, or for process drying, wherever air motion must be controlled. In homes they can be installed inside in a living room, in a closet provided with proper clearances, beneath the floor in the crawl space, or above ceiling in attic.

Kilbury Mfg. Co., Inc., Lawndale, Calif.

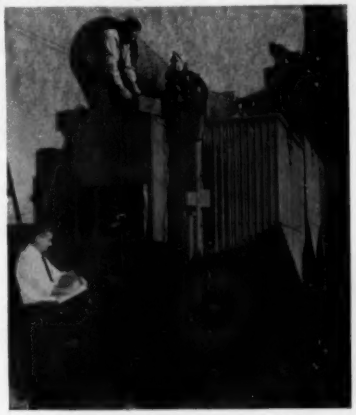
BIDDLE *Instrument News*

USE OF THE "TTR" TRANSFORMER TURN RATIO TEST SET ON INDIANAPOLIS POWER AND LIGHT COMPANY SYSTEM

N. J. Galuppo, Transformer Engineer

We have found greatest application for the Biddle "TTR" Set on power transformer regulators. This instrument is so simple to operate that any workman, doing maintenance work on transformers, can be relied on to make accurate checks after a few explanatory measurements on a simple transformer which is in good condition.

There have been several instances recently where, after repairs on both no-load and under-load tap changers, we have found the "TTR" very reliable in checking proper sequence of the tap range, before placing the transformer or regulator back in service.



Courtesy Indianapolis Power & Light

In cases where both H. V. and L. V. bushings are brought through wall bushings into cable compartments, we find the "TTR" particularly advantageous. By lowering the oil in the unit, a man can safely make ratio and polarity checks while inside the transformer without any danger of using an unsafe voltage.

Routine checks on new power transformers and regulators include ratio and polarity checks as indicated by the "TTR".

After any repairs are made on used equipment, it must be checked by the "TTR" before it is placed back in service. This instrument is used to test ratio and polarity on single-phase and 3-phase transformers, 5 kva to 83,500 kva inclusive.

The "TTR" operates on the principle that, under no burden, the terminal voltage ratio of a transformer is almost exactly equal to its turn ratio. When two transformers are connected in parallel and excited, there will be a circulating current between their secondaries unless the turn ratios of the two transformers are identical.

The photograph above shows the "TTR" Set being used to check ratio and polarity on a new transformer with under-load tap changers, previous to placing in service.

Write for BULLETIN 55-ECM

Announcing . . .

A 5 KV MODEL BIDDLE IMPULSE CABLE FAULT LOCATING TRANSMITTER

Model 5, 5 KV, 16 MUF

Write for BULLETIN 65-ECM

New Dolly, available as an accessory with both Models 4 and 5 Biddle Impulse Cable Fault Locating Transmitters

8J405

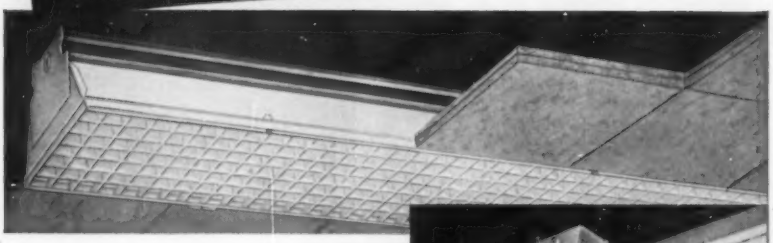
JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

How to Make CEILINGS Help SELLING

Sylvania's new fluorescent troffers offer great variety of attractive ceiling lighting patterns and effects.



When it comes to putting your customers' products in a more appealing light, tell them about Sylvania's new line of improved recessed troffers.

Sylvania Fluorescent Troffers make lighting an integral part of the ceiling, and offer a practically endless variety of lighting patterns. Available in lengths from 2 feet to 8 feet, Sylvania Troffers come with six different types of shielding and with instant or standard-start lamps.

In addition, Sylvania offers matching corner spotlights for dramatic accent lighting. New illustrated folder gives complete information and detailed application data. Write Sylvania, Dept. 4X-2402, for your copy NOW!

SYLVANIA

Sylvania Electric Products Inc. 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine St., Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

Air Conditioner (40)

Year-round room air conditioners in ½-, ¾- and 1 hp sizes. Units deliver six different combinations of cooling, heating and ventilation, each of which may be selected by adjusting control. All models are equipped with a thermostat. When not in use, the illuminated and color-coded glider control is hidden. Design of cabinets makes possible installing them in any one of 18 positions, ranging from flush-mounted with window and almost fully outside room to fully inside room.

Amana Refrigeration, Inc., Amana, Iowa.

Radiant Heating Panel (41)

A radiant heating panel designed and constructed specifically for industrial applications. Long-wave-length black-body radiation from an area source assures temperature uniformity over large areas and maximum heat absorption, regardless of surface texture or color of material being treated. Panels are suitable for operation at temperatures as high as 350° C (660° F) and range in watt densities from 2.6 to more than 9 watts per square inch. Heating element is uni-directional and is backed with an aluminized steel reflector. Panels are made in two standard sizes, each 1¾ inches thick in overall dimension. The 13½-in. square panel is available in 500, 1000 and 1500 watt sizes and the 17½-in. by 25½-in. panel in 1000, 1500, 2000, 2500 and 3500 watt sizes. Booklet B-89 is available.

Corning Glass Works, Corning, N. Y.

Air Conditioner (42)

A new fully-automatic air conditioning unit features Timeset clock control. The 24-hour clock timer is available on ½-, ¾- and 1-ton deluxe models. Timeset clock dial is mounted on an inclined panel on front of machine. Timeset automatically starts the conditioner, turns the unit off during the cool hours of the night, and turns it on again before waking hour. Clock-dial is calibrated in terms of "morning", "afternoon", "evening", and "after midnight" settings and can be controlled within 15-minute intervals. They also include Thermoheat, which is an automatic built-in heating unit; and Thermoset, which is an automatic thermostatic temperature control. The unit extends 11½-in. into room. There are four grilles, adjustable in four directions.

Majestic Major Appliance Corporation, 79 Washington St., Brooklyn 1, N. Y.

Insulation Tester (43)

Designed for testing up to 30,000 volts ac, model 573A Hypot provides ac output voltage continuously variable from 0-30,000 volts at 1 kva capacity (1.5 kva intermittent). Input is 115-volt, 50-60 cycle. Short circuit protection is provided by a manually reset primary circuit breaker with secondary trip. Excess leakage current in test circuit is indicated

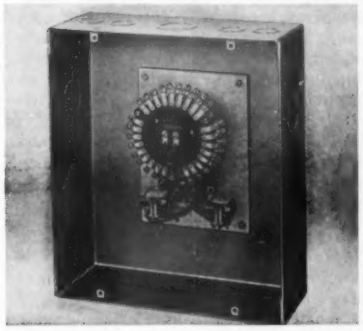
by panel-mounted neon lamp. Other features include 4½-in. output voltmeter connected directly across secondary, so that output voltage indication is not dependent on transformer design for accuracy, "on-off" switch with pilot light, non-locking "push-to-test" button, high voltage stand-off insulator and ground terminal on top of case. Applications include testing of motors, cables, transformers, insulators, etc.

Associated Research, Inc., 3752 W. Belmont Ave., Chicago 18, Ill.

Generator (44)

A new "Tractor-Drive" generator, designed for belt-drive and producing regular highline type electricity. Available in 3,000, 4,000, 7,000 and 10,000-watt capacities, it supplies the same 115/230-volt, 60-cycle ac delivered by commercial power lines. Mounted on a pivot-type base, it is equipped with a non-slip, flat belt pulley. Although designed to take overloads, a protective circuit breaker mounted in a box with convenient knock-out, guards against excessive overloads. A plug-in ac voltmeter, together with a single receptacle, permits tractor engine speed to be adjusted for desired voltage. Standard equipment includes an outdoor 2-pole, double throw, 60-amp manual transfer switch.

D. W. Onan & Sons Inc., Minneapolis, Minn.



Switch (45)

A new motor-driven master switch has been added to the G-E remote-control wiring system. Called the Circuit Servant, it is a 24-volt, 25-circuit switch, with each of the 25 circuits on the switch capable of operating one remote-control relay (RR-2), which in turn controls one lighting circuit. Driving mechanism of switch is energized by standard low-voltage remote-control switches which can be installed to control motor-driven switch from as many different locations as desired. Switch can be used in the home to control a pre-selected pattern of lights inside and outside the house. In factories, offices, and institutions, it can be used to control banks of lights. Motor-driven switch may be installed parallel or cascaded to control up to 625 lighting circuits. It is rated 3 amp, 25 volts.

General Electric Co., Bridgeport 2, Conn.

Rugged Twist-Lock TRADE MARK SINGLE FLUSH RECEPTACLES NO. 7582

A
Deep-slotted binding screws suitable for back wiring, side wiring or both (see diagram below).
B
Back wired holes provide for inserting wires straight into back of receptacle.
C
Strip gauge indicates amount of insulation to remove . . . eliminates wire looping.

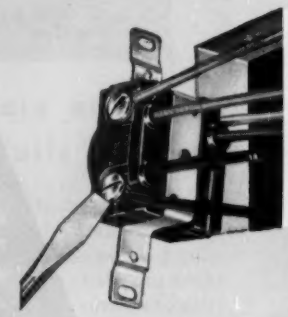
Now BACK WIRED

TO SAVE WIRING TIME . . .
PROVIDE GREATER VERSATILITY

Versatility . . . Suitable for back wiring, side wiring, or for the continuation of a circuit using combination of both. Back wiring makes unit adaptable for more products, especially where close wiring tolerances are encountered. Unit is available grounded.

Convenience . . . Back wiring permits easier, faster installation with no wire looping required. Strip gauge indicates exact amount of insulation to remove.

Electrician always has choice of side or back wiring method, or of continuing circuit using both. In this case, the same binding screw anchors both the back wire and the side looped wire. Positive contact is assured.



Shows how circuit may be extended utilizing both back and side wiring. Same binding screw anchors both the wire inserted through hole in back and the side-looped wire.

7580 Duplex Receptacle is also available with these same features.

SEE YOUR HUBBELL DISTRIBUTOR

Highest Grade HEAVY DUTY WIRING HUBBELL DEVICES

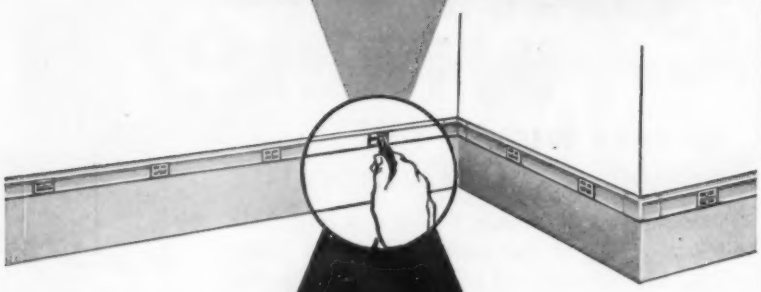
This attractive Twist-Lock Folder may very well have the answer to many of your wiring problems. Send for it today!

HARVEY HUBBELL, INC.

DEPT. C-1, BRIDGEPORT, CONNECTICUT

THH54

PLUGMOLD builds better business for you at a profit!



Modern ready-wired system provides multiple outlets!

GET A 20-FOOT PACKAGE of Plugmold 2000. Use it! You'll see right away why progressive electrical contractors all over the country are swinging to Plugmold 2000! It's the fastest, easiest, cheapest way to provide multiple outlets in homes, stores, factories, offices — in any building, new or old. Write today for full information.

Rely on Wiremold's "Big 4" to solve your wiring problems! Plugmold Continuous-Outlet Systems — Wiremold Surface Raceways — Pancake Overfloor Raceways — Wiremold Fluorescent Units.

The WIREMOLD Company

HARTFORD 10, CONNECTICUT

Product Briefs

(46) Labelon Tape Co., Inc., Rochester, N. Y., has announced self-adhesive plastic "Write on it" **tape** available in cut-to-size strips. . . . (47) A new type combination watthour **meter** and time **switch,** designed to control off-peak water heater loads, has been developed by General Electric Co., Schenectady, N. Y. . . . (48) New designs of concentric-ring **luminaires** for silvered-bowl incandescent lamps have been introduced by Westinghouse Electric Corp., Pittsburgh, Pa.

(49) Stanthony Corp., Burbank, Calif., has designed a **ventilating hood** for use over the range in smaller homes. . . . (50) A new automatic speed **control,** called Varitrol, has been designed into the Varidrive motors by Electrical Motors, Inc., Los Angeles, Calif.

(51) A new line of heavy duty **pipe wrenches** has been announced by the Toledo Pipe Threading Machine Co., Toledo, Ohio. . . . (52) Olympic Instrument Laboratories, Cove, Wash., has introduced a new wire and cordage **meter.** . . . (53) A basic new **switching method** for instrument monitoring by electronic scanning has been developed by the Kybernetes Corp., Newark, N. J.

(54) Sterling Transformer Corp., Brooklyn, N. Y., has introduced a new line of molded open type **transformers** —the "Clipper Series". . . . (55) A new shaded pole **motor,** Model 2800, available in 5 stacking lengths for various output powers is available from Howard Industries, Inc., Racine, Wis. . . . (56) Two new high temperature **resistors,** type PW-7 and PW-10, have been introduced by the International Resistance Co., Philadelphia, Pa.

(57) Automatic Electric Sales Corp., Chicago, Ill., has announced a new shock-resistant **relay** that combines relay and stepping switch functions all in one. . . . (58) A new 1½-hp **motor** has been added to the jet-pump line by General Electric Co., Schenectady, N. Y. . . . (59) Phil Rich Fan Mfg. Co., Inc., Houston, Texas, has developed two new 1 hp, 54-inch **fans.** One is a wall-exhaust fan, for vertical use, the other is an attic fan, designed for either vertical or horizontal use.

(60) A new Pengo **pole grip** used for setting power poles up through energized power line is in production by Petersen Engineering Co., Santa Clara, Calif. . . . (61) A new ratcheting chain **wrench** manufactured by the Owatonna Tool Co., Owatonna, Minn., was built especially for electrical and plumbing contractors. . . . (62) A new "Surface-Barrier" **transistor** for military and civilian uses has been developed by Philco Corp., Philadelphia, Pa.

(63) Marvin Manufacturing Co., Los Angeles, Calif., has developed a fibre glass **gasket** which stops light leakage around fixture frames.

CATALOGS and BULLETINS

(64) LIGHTING FIXTURE BRACKETS, hangers and pole units; metal pole units include single and double-arm models for pendant type street lighting units or bail suspended floodlights with choice of tapered, round aluminum alloy poles or round, fluted or octagonal steel poles. Wall and wood pole brackets are ready for wiring and erecting; suitable for new installations or rapid conversion of existing facilities using either pendant or floodlight type luminaires. Accessories include adapters for lighting units, yokes for twin floodlights, overhead wiring pin feeder brackets, ballast and transformer supports, wiring entrances and other items. New 32-page catalog includes complete descriptions, specifications and dimensioned drawings of all equipment. Thompson Electric Co.

(65) CABLE SIZE SELECTION; a simple method for selecting the proper conductor size for heat-resistant types of wire and cable in installations typical of those coming under the Code. 12-page bulletin. General Electric Co.

(66) ELECTRO-MAGNETIC RELAYS; a brochure entitled "Symposium on Electro-Magnetic Relays" gives all factors pertinent to the design, manufacture and use of relays; contributors include relay manufacturers, equipment manufacturers and government personnel. Potter & Brumfield.

(67) REFLECTORS for fluorescent and slimline lamps; full descriptions of 8 basic units with detailed specifications, application notes and installation data; included are 1- and 2-lamp models, 20- and 40-watt sizes, 25 and 49 inches long; units may be open, louver-shielded or equipped with Alba-Lite diffusers. 4-page folio R-54. Gruber Lighting.

(68) DISTRIBUTION REGULATORS for substation use or for mounting on pole or platform near loads; standard accessories and specifications for the Type JFR regulator available for use with 2500, 5000, 7620 and 14400 volts. Allis-Chalmers Mfg. Co.

(69) SERVICE DROP AND SECONDARY CABLE with both copper and aluminum conductors and with either Neoprene or polyethylene insulation; specifications, physical data, and sag and tension data. 8-page bulletin RS-5. Rome Cable Corp.

"Exposed conduit jobs made more attractive with portable Greenlee Hydraulic Bender"

Here's the experience reported by Canadian Comstock Co., Ltd., Montreal electrical contracting firm, in using GREENLEE Benders on the above job involving installation of conduit in sizes ranging from 1¼" to 4".

Through the use of GREENLEE Benders this company reports that it is easy to make matched bends in multiple conduit installations and make exposed jobs more attractive.

Also by bending conduit they eliminate manufactured elbows and other fittings and thus make possible good use of standard 10-foot lengths. Since it is not necessary to cut the conduit at every turn, many short, useless lengths are done away with and it is easier to calculate the entire amount of conduit needed. Like this firm, which has 27 GREENLEE Hydraulic Benders in use, you, too, can make valuable savings and turn out better jobs with this remarkable tool.

With the GREENLEE Bender, *one man* quickly makes smooth, *accurate* bends in pipe up to 5", rigid and thin-wall conduit, tubing, bus bars. Available in two sizes. Often pays for itself on the first few jobs through big savings of time and materials. Write for facts today. Greenlee Tool Co., 1742 Columbia Ave., Rockford, Illinois.

TOOLS FOR CRAFTSMEN
GREENLEE

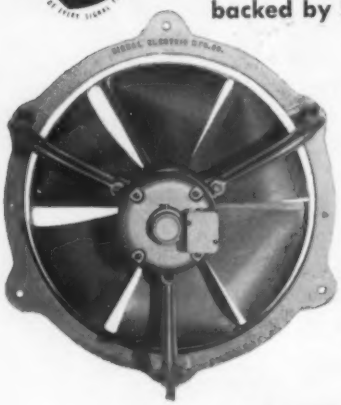
OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Cable Pullers • Knockout Tools • Auger Bits and Drills

exhaust fans

with inexhaustible profit opportunities

Ruggedly built by Signal with world's finest motor backed by Signal's Guarantee 1



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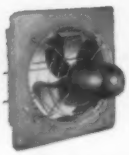

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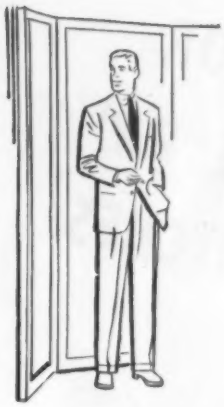

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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

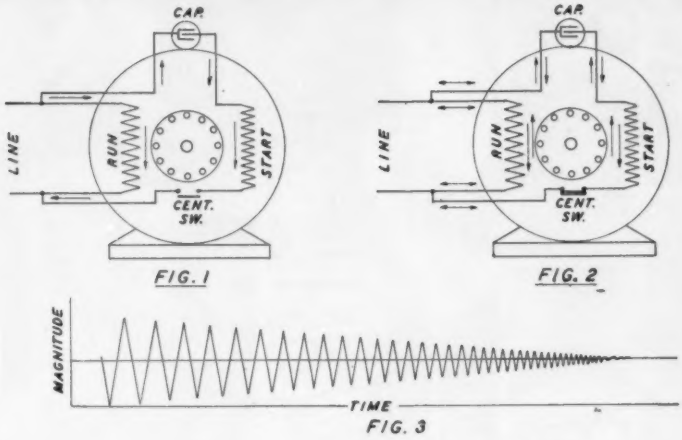
Reader's Quiz

Capacitor Start Motors

QUESTION W24—What would cause a single phase condenser start electric motor to stop, when the starting switch closes, permitting the condenser to discharge in the winding, after you open the line switch? I would think that the discharging of the condenser would tend to make it continue to run till the condenser has been discharged.—R.E.G.

ANSWER TO W24—Your question regarding the braking effect common to capacitor start motors is caused by two predominant qualities of its X-C circuit. De-energizing this motor—and thus closing the centrifugal switch will, in many instances cause a "plugging" current to flow, therefore slowing the rotor rapidly. However, this action can be erratic due to the direction of rotation combined with capacitor polarity and discharge.

By far the greatest cause of this self-braking phenomenon is due directly to the current oscillations set up in the X-C circuit after power is removed.



Note Fig. 1 which indicates current flow during a normal "start". Upon disconnecting the line and with speed subsiding sufficiently for centrifugal switch closure, we have a series circuit composed of running winding, starting winding and capacitor. With these capacitors ranging in size up to 180 mfd. the high impedance of this path is quite obvious; see Fig. 2.

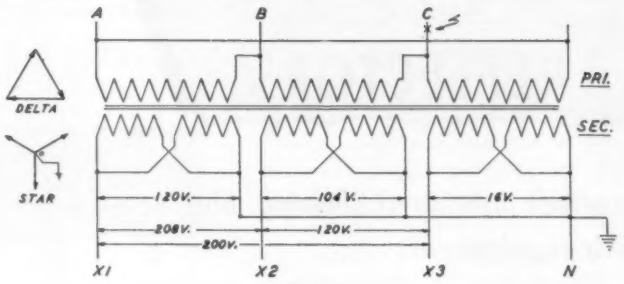
The peaked sine wave oscillating in this circuit is illustrated in Fig. 3. Note that its magnitude dwindles to zero within an undefined period of time. Oscilloscope tests have registered these oscillations in periods of a few to several thousand cycles at frequencies far above the applied power frequencies, their duration depending upon the circuit constants.—R.R.T.

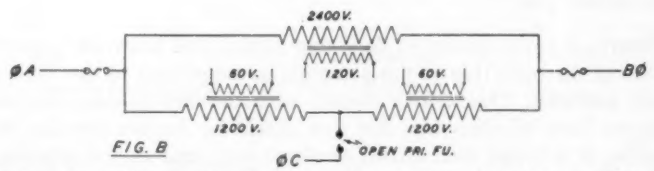
Motor Protection

QUESTION Y24—An automatic washing machine installation consisting of 25 Laundromats suddenly started giving trouble; 8 or 9 of the motors overheated badly and some burned out. The motors are ½ hp, 120 volt, single phase, and are protected against locked-rotor current only. The source of power is a bank of three 15 kva transformers, connected delta-star, 2400 volt, 120/208 volt, three phase, 4 wire. There are three primary fuses.

When the machines started smoking, all of them were unplugged, and a voltage check was made. Two phases showed the normal 120 volts, but the third phase showed only 55 volts. Presumably, it was this low voltage that caused the burnout of the starting winding on some of the motors. A check of the transformers showed that one primary fuse had blown. Upon replacing this fuse, everything was normal.

Three phase motors could be protected against this casualty by providing running protection in all three legs, but is there any way of similarly protecting single phase motors? Will someone give a vector diagram showing just what happens when one fuse of a delta-star bank blows? The standard textbooks are silent on this subject.—A.O.H.





ANSWER TO Y24—In answering this question, the writer roughly computed the various phase-to-phase and phase-to-neutral voltages in a vectorial manner. To double-check these figures, he pulled one primary oil fuse serving a delta-star bank of lighting transformers (25 kva capacity each). Before applying the voltmeter, all secondary

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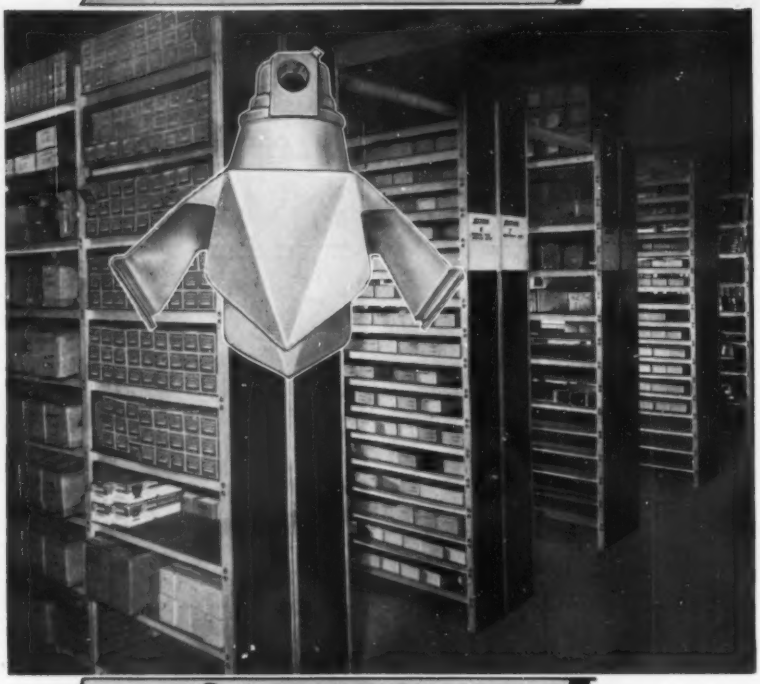

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load was removed. Fig. A indicates the voltmeter readings and Fig. B indicates the measured voltages after the star point is opened. Fig. B is an elementary graphic diagram illustrating this single-phase condition. Note that one primary winding receives full voltage while primary windings No. 2 and No. 3 are in series across the line, each winding receiving half voltage.

The various impressed voltages across the fully connected secondary is caused by the circulating currents through the star or neutral conductor. Various loads will radically change the potentials measured except the 120 volts across the A-B phase (X1 to ground).

Your most successful motor protection would be the installation of single-pole thermal switches (motor starters), with a heater value of 115% above your ½ hp rating, in this case, 9.2 amp.

Protective devices are not required in the neutral or grounded conductor, and need be applied to only two conductors of a 3-phase motor service.

A more expensive and involved protection would be the application of undervoltage relays or a reverse-phase-single-phasing relay in conjunction with a 150 amp, 3-pole magnetic contactor at the secondary service.

The most reasonable protection in cost and labor would consist of replacing your present fuses with either fusestats (plugs) or fusetrons (cartridges) of the proper value (9.0 to 9.5 amp).—R.R.T.

Lubricating Ball Bearings

QUESTION V24—Which is the best to use in lubricating ball bearings, an alemite type gun fitting or a grease cup? We have had quite a discussion over the merits of both types, but our mechanics seem to favor the grease cup because it will not pack a bearing too tight with grease.—L.W.F.

ANSWER TO V24—This is a controversial subject. Actually both will serve if used intelligently, and both will do more harm than good if misused. Good lubrication means the regular addition of sufficient grease to permit smooth operation and prevent unnecessary wear. Too much lubricant will break through grease seals and get into motor windings, cause the bearing to run hot and break down the lubricating properties of the grease, and in general create havoc within the machine.

On the other hand, insufficient lubrication will encourage early bearing

19% more starts on rapid-start lamps with Sola Constant Wattage Ballasts

RAPID CYCLING TEST: In Sola's laboratory an accelerated-start life test (½ minute on, 1½ minutes off) was conducted using the rapid-start fluorescent lamps of three different manufacturers. Lamps of each brand were operated from both the Sola Constant Wattage Ballast and another leading make of ballast. The photograph shows two remaining lighted lamps, Sola ballasted, which finally failed after 67,560 starts. The results of the test are summarized in the table below.

RAPID CYCLING TEST, 106v.

RAPID-START LAMP MAKE	LIFE SPAN SUPERIORITY OF SOLA BALLASTED LAMPS
Brand "A" Lamp	46.7%
Brand "B" Lamp	14.7%
Brand "C" Lamp	9.7%
Average All Lamps	19%

Ease of starting rapid-start lamps, and length of lamp life from starts, is proportional to the open circuit ballast voltage. Sola Constant Wattage Ballasts have a higher open circuit voltage (300v) from the lamp to the starting aid for positive starting. They are completely safe due to their isolated secondary circuit design . . . listed by Underwriters . . . and CBM Certified.

Repeated tests in the laboratory, and performance on actual installations show that rapid-start fluorescent lamps operating from Sola Constant Wattage Ballasts form an almost perfect lighting system: long lamp life with frequent starts or continuous operation, and lumen output constant within ±2% regardless of line voltage variations from 106-130v.

The many dollars saved on relamping more than absorb the 5c per year price premium of Sola Constant Wattage Ballasts over ordinary ballasts.

Saves dollars in maintenance for only 5 pennies a year

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This WAGNER Two-Piece Compression Connector leaves wiring room inside the box. No locknut is needed. It is approved for all inside work or embedding in concrete. Assures an extra tight bite against wall of box. You need only one wrench for fast, easy installations.

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failure. Between these two extremes is the proper amount—just enough to enable moving parts to slide freely and to cover precision surfaces with a thin protective coating.

Frequently bearings can be packed with the proper amount of grease when applied and run without further lubrication until the next overhaul period. When suitable, and when overhaul periods are carefully scheduled and observed, this is most satisfactory. An extension of this idea is the use of prelubricated sealed bearings, which eliminate guesswork.

The important factor in lubrication is to grease on a regular schedule with just enough lubricant to keep the bearing coated. When greasing is done on a systematic basis, too little lubricant is better than too much. Actually, the exact method of greasing is unimportant if it is used properly and with suitable care.—D.H.N.

ANSWER TO V24—With the advent of modern long lasting lubricants, most motor manufacturers are adopting the positive pressure method of lubrication employing grease fittings. The bearings which are so equipped are provided with a relief plug or similar device to allow excess grease to pass out of the bearings. These bearings are greased while the motor is in operation, using the following procedure.

Remove the relief plug and any hardened grease that might obstruct the opening. Then add clean grease through the gun fitting until the old grease has been expelled through the relief openings.

This method of greasing provides a positive method of lubrication and assures a maximum of new clean grease in the bearing. The proper use of the relief plug obviates any possibility of packing the bearing too tight.—L.D.B.

Magnetic Controller

QUESTION X24—On a 3 phase 220 volt motor, I found that the nameplate read 1 amp but lead A drew 1.15 amps —leads B and C drew .75 amp. In what leads should I connect the two heaters of the magnetic controller to protect the motor?—H.S.

ANSWER TO X24—It would appear to me that something is wrong with the motor when the different phases read ⅓ less current than the high one. I would suggest that this motor be carefully checked prior to any heaters being installed; in fact, before the motor is used at all. A change of between 5% and 10% in phase currents is all right and to be expected, but certainly not 40%.

With such small changes as men-

tioned above, it would make no difference in what lead the heaters were actually put.—H.H.S.

ANSWER TO X24—The heaters would be connected to leads B and C because they would have a 1 amp full load protection, which would give you 125% overload protection. If the 1 amp, full load heater were placed in the line lead, drawing 1.15 amps, then the switch would trip open, and you would have to increase the size of the heater on that lead.—E.H.

Can you ANSWER these QUESTIONS?

QUESTION L25—What is the maximum percentage of speed reduction that is practical on a shaded pole motor? What is the best method of varying the speed?—H.G.C.

QUESTION M25—Most fluorescent manufacturers offer a standard plan to anticipate failure of their lamps. We have a large number of incandescent lamps and are interested in such a preventive maintenance schedule, as regards lamp life. Do any readers have such a plan now in operation in their plants and how is it set up and handled?—L.W.F.

QUESTION N25—I heard two competent engineers discuss electronic tubes. Part of the subject was how can a longer life be had from tubes. One engineer said that if the tube is in a vertical position it will last much longer. The other one said that this has nothing to do with tube life. Who is right?—M.D.

QUESTION P25—Nowhere can I locate a definition or description of what dynamic braking is or how it is accomplished. I understand that it requires a dc voltage to the revolving field of the synchronous motor. How does the dc voltage accomplish dynamic braking and what is the effect on the braking if the motor is running and the dc supply is interrupted? This subject is apparently quite important in industrial installations involving synchronous motors, and I would like to have references or information on it.—A.L.D.

QUESTION Q25—In installing duplex receptacles, can I connect a second duplex outlet to the first by connecting on the first duplex receptacle, or would it have to be from a junction box?—L.R.L.

PLEASE SEND IN YOUR ANSWERS BY MARCH 15

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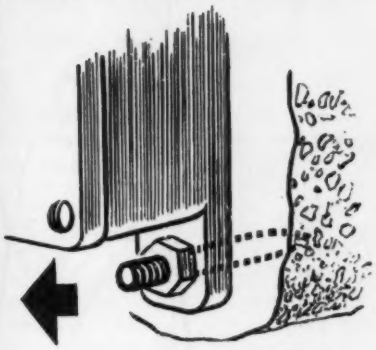
WITH
BREAK-OPEN ACTION



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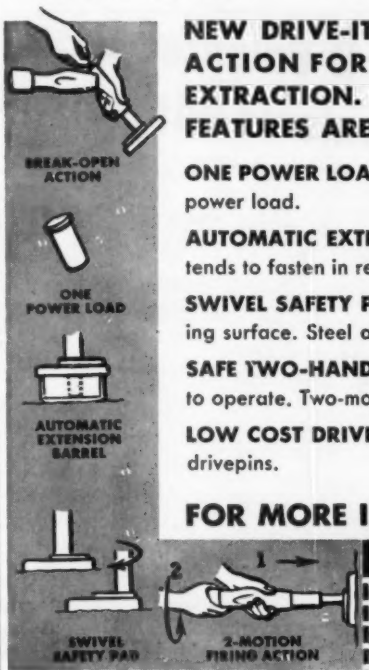

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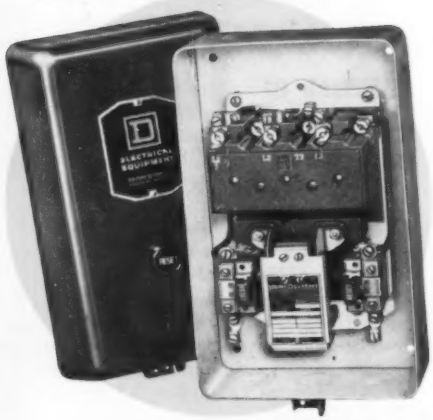

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Questions on the Code

Answered by

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GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

Service Equipment Multiple Occupancy

Q. *In a 4-6- or 8-apartment building, each apartment has six circuits. Can the following installation be made, and would it comply with all code regulations?*

Notice that since a master switch is installed ahead of the entire individual panels, we are not having a main disconnect for each individual apartment or panel.—A.M.S.

A. According to the diagram, we have a multiple-occupancy building which is served through only one set of service entrance conductors. Each occupant is served through a separate meter. A main switch without fuse is installed ahead of the individual meters and overcurrent panels serving each occupant. Section 2351 of the Code requires each set of service entrance conductors to be provided with a readily accessible means of disconnecting all conductors, except the grounded conductor, from the source of supply. In the illustration, this Code provision is satisfied by the main disconnect shown.

Section 2371 covers the overcurrent protection required for ungrounded service entrance conductors and recognizes under exception No. 3 not more than six sets of circuit breakers or fuses as satisfying this requirement. In a multiple-occupancy building, a further exception under No. 4 is made, which makes a distinction between a building having individual occupancy above the second floor and one that does not have such an occupancy. In the first case there could be only one set of service entrance conductors with the overcurrent protective devices grouped in a common accessible place and limited to not more than six circuit breakers or six sets of fuses. I believe that the new 1953 provisions covered by the last two sentences of Section 2351-a, which concerns "handle ties" or handles within ½-in. proximity would also apply. It therefore follows, in my opinion, that the design shown by your diagram would be in violation of the Code if the building involved had individual occupancy above the second floor.

In the second case, no occupancy above the second floor, Section 2371a-4 permits an unlimited number of sets of service entrance conductors and each set protected by not more than six sets of breakers or fuses. Since you have only one set of service entrance conductors, you would be limited to six sets of fuses or breakers. It therefore appears to me that the diagram is again in violation of the Code.

In order to further clarify the matter, I have shown by Figure No. 2, the case of a multiple-occupancy building with no occupancy above the second floor where the number of disconnects and overcurrent devices are unlimited. Part of such a design is covered by Section 2301 which permits two or more separate sets of service entrance conductors to be tapped to one service drop for the purpose of serving each individual occupant.

If you had used a fused main switch, it is quite possible that your design would comply with the Code, provided the main fuse did not exceed 200 amperes. Section 3883 and the taps to each panelboard complied with the requirements of Section 2434c-d. In such a case the service rules would stop at the load side of the main fuse.—B.A.McD.

Fig. No. 1

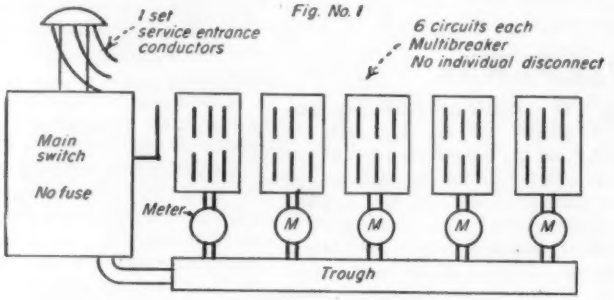
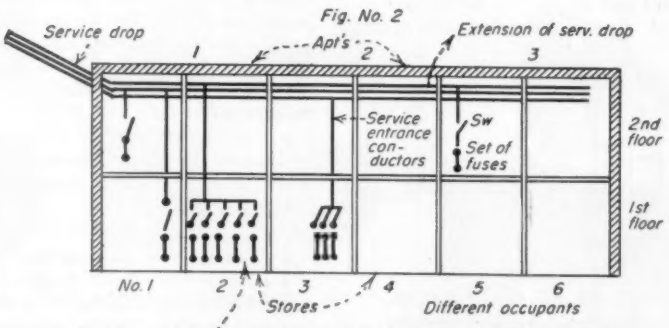


Fig. No. 2



No 3rd floor. Main switch & fuse or C.B. Maybe 6 for each occupant. No. of service entrance conductor sets not limited.

Outdoor Wiring

Q. *By what code rule does one use smaller than No. 8 wire for outdoor spans over 50 feet? Our local contractor insists there is no limit to size or span length if wire is large enough for load. It seems to me that Section 7314-b would prohibit smaller than No. 8 for 440 volt on long spans.* —R.D.O.

A. Section 2304-b does permit No. 10 soft drawn or No. 12 medium hard drawn or hard drawn wire for service drops. However, I believe the intent is to permit this only in the case of service drop cables.

For general wiring 7314-b would require No. 8 minimum, as you indicate in your discussion.—B.Z.S.

Recessed Fixtures

Q. *Please clarify Article 410, Rule 4179 Paragraph B. Does this rule out recessed fixtures which have the junction box made on to the fixture with a light space between and with rock wool insulation?—A.M.S.*

A. Section 4179 of the Code provides for the wiring of a recessed fixture and requires, in general, that conductors suitable for the temperature encountered shall be used. This statement is clarified by the further advice which tells us that fixtures, having terminals which operate at temperatures higher than 60°C (140°F), shall have circuit conductors as described in 4179 a or b. The rule in question, 4179 b, requires a recessed fixture whose terminal connections operate at temperatures in excess of 60°C to be connected to the branch circuit conductors through the use of an outlet box placed at least one foot from the fixture. From this box tap conductors having insulation suitable for the temperature encountered shall be run through suitable metal raceways, at least 4 feet and not more than 6 feet in length, to the fixture. The significant feature of this rule is the fact that it applies only when the fixture terminals operate at temperatures in excess of 60°C. While such operating temperatures are usually the case, some recessed fixtures are designed so that their terminals operate at 60°C or less, and in such cases the junction or outlet box could be mounted on or within one foot of the fixture. In order to determine this feature of a fixture, Underwriters' Laboratories advise us that any recessed fixture labeled by them will be distinguished with respect to operating temperatures as follows:

"Recessed fixtures which attain temperatures exceeding 60°C (140°F) at the point where supply connections are to be made are marked at the point of supply connection to indicate the temperature for which supply conductors are to be suitable. The absence of such marking indicates that 60°C (140°F) supply conductors are suitable".

It therefore follows that if any of the recessed fixtures under question are labeled by U. L. with the "recessed type of fixture label" and no notation is made with respect to the terminal operating temperature, then the branch circuit conductors rated for 60°C may be brought direct to the fixture or the junction box attached to same. It is important to see that any such fixture is approved by U. L. and bears their recessed fixture label.—B.A.McD.

Type S Fuses —

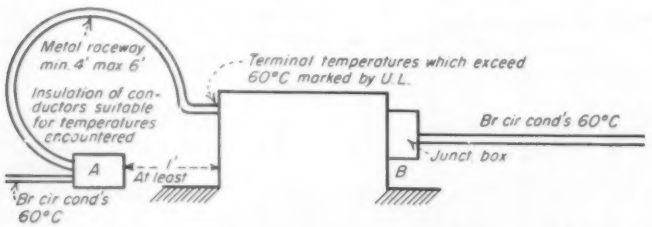
Q. *May plug fuses of the Type S type be used for the protection of a three phase motor operating an air conditioning unit in an ordinary dwelling?*—A.M.N.

A. Yes, if the dwelling is supplied from a star or a wye connected transformer so no phase operates in excess of 150 volts to ground as provided under paragraph a. of Section 2403. It is stated that plug fuses and fuseholders shall not be used in circuits exceeding 125 volts between conductors except in circuits supplied from a system having a grounded neutral and no conductor in such circuit operates at more than 150 volts to ground. If, on the other hand, the dwelling in question is supplied by a delta connected secondary where you may have only two phases operating at less than 150 volts to ground, it is necessary that cartridge type fuses be employed.—G.R.

Type MI Wire

Q. *We construct packaging machines for the packaging of cereals and are considering the use of the new MI type wiring material for these machines, due to the fact they are often used in dusty locations requiring the use of wiring approved for Class 2 locations. Because of the bulkiness of rigid conduit used heretofore, we would like to use the MI wiring material. The problem, however, of identifying the individual conductors within the control equipment on this machine has been brought forth. What are the Code requirements for such identification?*—F.F.O.

A. Section 2005 of the National Electrical Code simply states that conductors of Type MI wiring shall be identified by distinctive markings at the terminals during the process of installation. Then under paragraph a. of Section 2006 you will note the grounded conductor may be identified by means of paint applied at each terminal. However, I believe the simplest and best method of identifying all conductors of MI wiring would be through the use of colored spaghetti such as that now used on radio wiring. This material is readily available in many different colors and a short length of spaghetti pushed over each conductor within terminal fittings will provide permanent identification of those conductors, as the color is throughout the material from which this tubing is produced.—G.R.


Metal raceway min. 4' max 6'
Insulation of conductors suitable for temperatures encountered
Terminal temperatures which exceed 60°C marked by U.L.
Br cir cond's 60°C
Junct. box
A
At least 1'
B
Br cir cond's 60°C

Case A. Fixture terminals operate in excess of 60°C and must be wired as shown.

Case B. Labelled fixture, U.L. approved, which is not marked at terminals indicates that the 60°C branch circuit conductors may go direct to the box. Such fixtures usually limit, by design, the maximum size lamp to be used.

Circuit Breaker Ratings

Q. *I have a question on the de-rating of circuit breakers in panelboards that has been puzzling me. The manufacturers of the molded case type of breakers recommend a de-rating factor of 15% when circuit breakers are installed in enclosures in addition to the de-rating factor for the ambient temperature.*

The local inspection authorities recognize only the nominal rating of the breaker, the rating calibrated at 25° C ambient.

For a load ultimately to carry 320 amperes, we must put in a 400 ampere feeder breaker (the 400 amperes de-rated 20%) and the feeder copper must be good for 400 amperes. For a 400 ampere load, the circuit breaker should be 500 amperes (according to the manufacturers) and the copper must be good for 500 amperes (according to the inspectors). For long runs in the large size this seems like an unnecessary expense. The inspectors say a load equal to the rating of the breaker may some day be applied. But the manufacturers say the breakers will trip at about 80% of their rating in the enclosures. In the meantime the customer is paying for a great deal of copper.—T.G.B.

A. It is quite possible that some makes of circuit breakers will carry dual ratings, i.e. with an enclosure and without. Generally, however, the manufacturer will state definitely

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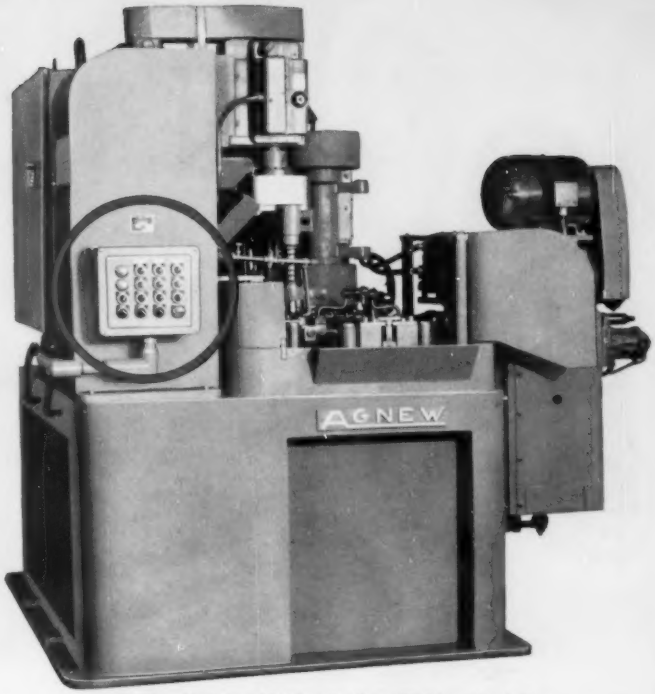
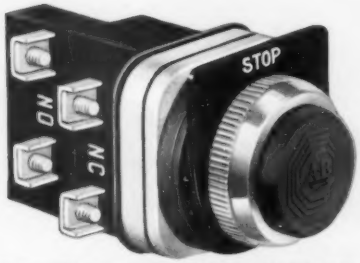
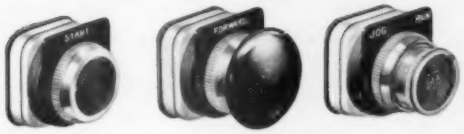


Agnew Milling Machine with Allen-Bradley oiltight master station.



BULLETIN 800T PUSH BUTTONS



CONTACT BLOCKS—OPERATORS

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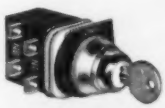

Key-operated Push Button

Pilot Lights in various colors

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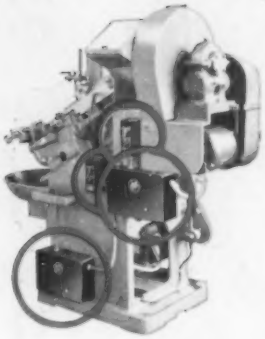
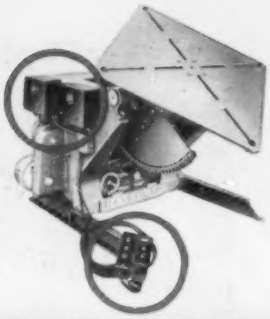
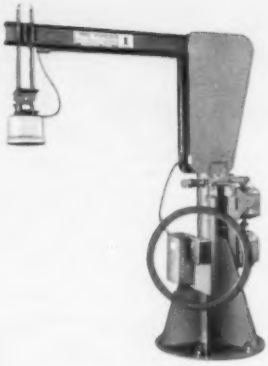
BULLETIN 800T PUSH BUTTONS



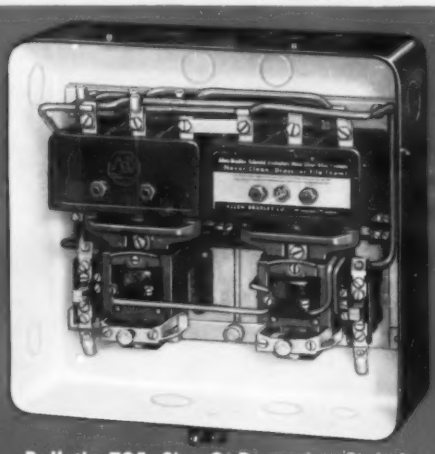
Two Allen-Bradley Bulletin 705 solenoid operated reversing switches on Waterbury-Farrel screw thread rolling machine.



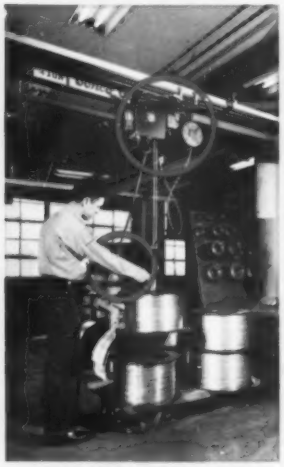
Two Allen-Bradley Bulletin 705 reversing switches on Ransome welding positioner. Push button stations are attached to flexible control cable.



Morris-Wheeler pillar type jib crane equipped with Allen-Bradley Bulletin 705 reversing switch to control the horizontal swing of the crane.

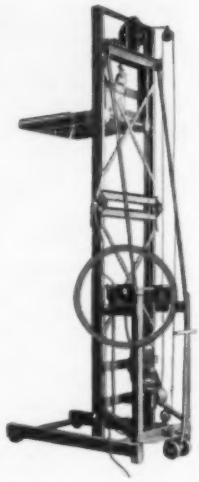


Bulletin 705, Size 2, Reversing Switch.



Bulletin 705 reversing switch on Conco ¼ ton electric hoist for lifting copper wire reels in wire mill.

Bulletin 705 reversing switch for Greaves No. 2 milling machine. Master push button station is at top of the milling machine.



Mercer materials handling hoist equipped with Allen-Bradley Bulletin 705 reversing switch.

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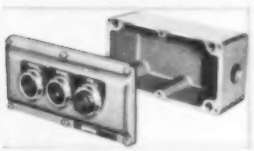

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BULLETIN 705 REVERSING SWITCHES

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just what the rating of his particular breaker is based on.

As for the load it is not always true that the copper capacity must be commensurate with the circuit breaker capacity as you outline in your third paragraph. For example in the case of a motor load or combination motor and lighting feeder, it is possible to have a circuit breaker rating far in excess of the conductor capacity. Thus in the case of a 60 hp, 150 ampere, 220 volt, squirrel cage three phase motor with across the line starting, the maximum size of circuit breaker that could be installed would be

2.5 x 150 or 375 amperes.

The next standard size circuit breaker available would be a 400 ampere size.

The wire size however, would have to have a minimum capacity of 1.25 x 150 or 187½ amperes. Thus a 3/0 Type RH would be sufficient.

In some cases a larger size wire may be required. Suppose a feeder must supply a 600 ampere load for a 3 wire, 3 phase system. Let us assume further, that we want to supply this in a single conduit line with wires not to exceed 500 MCM in size.

A type RH, 500 MCM conductor has a capacity of 380 amperes. Therefore, it will be seen that at least two wires per phase will have to be used for this load. In all, six conductors may have to be installed in the conduit and under these conditions each conductor must be derated 20%. On the basis of each conductor per phase carrying one half the total load, the minimum current carrying capacity of each conductor must be 300/.8 or 375 amperes. Therefore, two 500 MCM Type RH conductors per phase must be installed. The actual maximum capacity shown by Table 1 is 380 amperes. So we must install in this case 760 amperes of capacity for a 600 ampere load.

It should be noted that Sections 2116 and 2125b will automatically derate the circuit breaker and branch circuit where maximum loads of a branch circuit will continue for a long period of time.—B.Z.S.

Grounding Panels To System Grounding Conductor

Q. *I would like to know if it is a code violation to install a neutral bar in a lighting circuit cabinet which would be drilled and tapped directly to the metal of cabinet box, and attach neutral circuit wires to it. What are the objections to it, and why*

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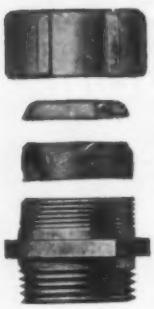

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Having no regular lighting feeders but deriving our lighting feeders from a single phase of our 440 volt non-grounded system, we use transformers of 440 volts for primary and secondary 110-220 volts, 110 volts to ground. We use one transformer or more in a building every time we need a lighting feeder. Or is it enough to just ground the center tap of the secondary to the case of the transformer to get a ground on the 110 volts, there being no ground wire ahead of the water meter; and in this case must there be a ground wire ahead of meter or not, to the equipment as the 440 volt is not grounded? There are many buildings covering a large area.—G.K.

A. Section 2561 of the Code permits the grounded service conductor on the supply side of the service disconnecting means to be used for grounding the meter housing and service equipment. The same rule prohibits the grounded circuit conductor on the load side of the service disconnecting means to be used for grounding equipment except for the frames of electric ranges as covered by 2560 and by special permission as covered by 2557-c. It would therefore be a Code violation if you installed the neutral bar in a lighting circuit panel direct to this metal enclosure without insulating it from the cabinet.

The reasons for this restriction are briefly covered as follows: Up to the present time the Code, in general, restricts the interconnection of system and equipment grounds to service equipment, and field experience indicates this to be a safe procedure. The question of extending this procedure beyond service equipment has been considered but the possible hazards produced by such action exceed by far those presented when only service equipment is involved. The principal reason concerns the possible reversal of polarity which especially in the case you mention could easily make the cabinet and the metal raceways or cables connected to it live and so create a life or personal injury hazard. Replacing a defective transformer could easily result in a reversal of polarity especially when the workman is incompetent or negligent.

The same reasoning holds true when insulating transformers are connected to power circuits for the purpose of obtaining 110-220 volts for lighting. Section 2526 refers to such an installation as an isolated system and requires the secondary neutral conductor to be grounded. It is my opinion that the equipment such as the transformer case and the cabinet should not be connected to this secondary system

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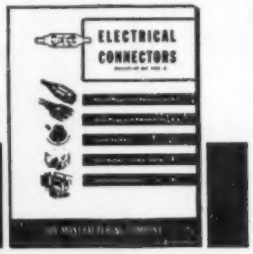

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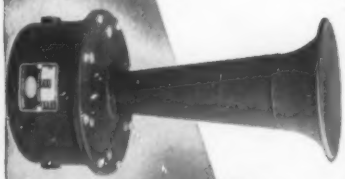

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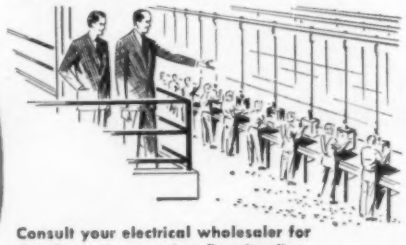

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grounding conductor. Undoubtedly the 440 volt equipment, including the metal raceway feeding the transformer, is grounded as required by the Code and the transformer is metallically connected to the grounded 440 volt equipment. If we ground the secondary of the transformer to the transformer case, the ground circuit would include all of the conduit, boxes, panels etc. that were in the circuit to the grounding connection at the service. This would be a Code violation.

It is my opinion that the secondary of the transformer must be separately grounded to a cold water pipe as covered by Section 2581. The connection should be made, as covered by Section 2612, as near as practicable to the water service entrance to the building. The Code does not definitely require the connection to be on the street side of the water meter but it implies, in my opinion, that such procedure is desired in many cases. If the connection is not made on the street side of the water meter all unions, valves, and meters shall be bonded as covered by Section 2612. The last sentence of this rule is significant since it tells us that equipment may be grounded to a cold water pipe near the equipment. This points out the distinction between an equipment ground conductor and a system ground conductor and emphasizes the necessity for more rigid requirements when system grounding conductors are involved.—B.A.McD.

Connector For EMT And Greenfield

Q. *May a connector tieing in "Greenfield" and EMT be buried in concrete?*—E.C.P.

A. EMT may be embedded in concrete and if connectors are used they must be made up tight and also must prevent water from entering the raceway.

Greenfield by inference, may be embedded in concrete. Article 350 for Flexible Metal Conduit does not state where it may be used. However, armored cable with lead covered conductors may be embedded in concrete (see Section 3342). While no reference is made in Article 350 to this particular section it may be inferred that the flexible metal conduit may also be embedded in concrete if lead covered cables are used.

There is no reference, however, in either Article 334 for Armored Cable or Article 350 for Flexible Metal Conduit, to the use of connectors. While it may be possible to make the con-

SPEED INSTALLATION

with these Leviton surface type wiring devices

LEV-O-LETS speed surface installation *because* their narrow, 1¾" width allows for secure mounting on studs and joists only 2" wide or narrower . . . *because* they provide large terminals that make loop or clamp connections faster . . . *because* they provide bus bars for three-wire or thru-feed connections . . . *because* they can be used wherever non-metallic sheathed cable can be used. LEV-O-LETS are safe too—high barriers between terminals add extra insulation to the already low arcing characteristics of the sturdy, brown urea plastic used in their heavy duty construction. LEV-O-LETS meet R.E.A. and Federal specifications. Listed by U.L. and C.S.A.

LEV·O·LETS

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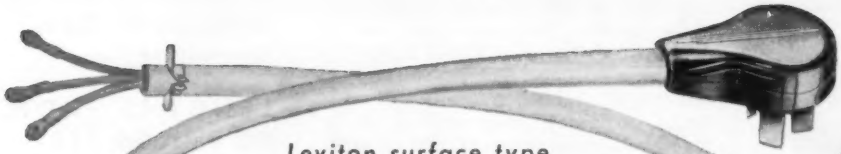

Leviton surface type

range receptacle and cord set

Receptacle is made of heavy duty bakelite, with self-positioning cover secured with a single screw. 5/16" diameter terminal screws with swivel washer cups assure fast, positive wiring. Cord sets in 3 foot or 5 foot lengths with *rubber molded-on cap* or *bakelite cap*. Listed by U.L. and C.S.A.

Send for Bulletin R

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Only "POWR-KORD" offers the complete safety of MOLDED-ON attachments...every component part fully UL listed

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nector water tight as required for EMT, in general, the standard connectors for flexible metal conduit would not be water tight. It would seem that the only solution would be to use lead covered cable throughout, and then the connector could be embedded in the concrete.

Offhand I cannot see why such a condition should be necessary, but it must have come to the attention of the questioner in the course of his work. This would definitely be a problem that local Code enforcing authority would have to answer for each such case as may come to his attention.—B.Z.S.

Residential Lighting High Voltage

Q. *I have received an application for inspection of an electrical installation in a residence and find it includes electrical discharge lighting fixtures of over 1000 volts. Job is very well executed and entirely safe in my estimation, considering the fact that oil burner equipment and T.V. includes higher voltages in residential areas. Article 410-Section 4183 states that equipment having open circuit voltages of more than 1000 volts shall not be installed in dwelling occupancies. The fixtures in question are protected in all respects for safety, including fuse protection which will open line side upon any fault in high voltage circuit. Please advise the course to follow in the future.*—E.S.G.

A. In view of the requirements of Section 4183, which are definitely stated, the only advice I may offer is to criticize and if necessary condemn any lighting system in a residential occupancy which involves the use of voltages in excess of 1000 volts. Any other action would, in my opinion, make the Inspector liable for damages in the event of personal injury which could easily occur when such equipment is installed in such an occupancy, and I do not believe he should assume such a responsibility.

It appears to me that the Code, in providing for the use of voltages exceeding 1000 for electric discharge lighting systems, recognizes a distinction between residential and other types of occupancies. In the first case the equipment is in the hands of the householder, inexperienced and untrained with respect to the hazards which exist, while in the second case, there is some assurance that such equipment will be maintained by experienced electricians who know from experience the hazards involved and

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- MOLDED-ON CAPS AND CONNECTORS
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THE film of water that condenses on a fluorescent lamp in wet weather is so thin the lamp hardly feels damp. Still, it can connect the ends of the lamp and set up a miniature short circuit. It doesn't injure the lamp. Just steals enough current so the lamp is slow in lighting.

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It has an invisible coating of General Electric silicone, called Dri-Film*. The photo shows what it does to water on the lamp. Makes it stand up in separate drops. In between are dry areas that break the electrical contact. The short circuit doesn't get started. The lamp does.

G-E Dri-Film* doesn't rub off. It's an example of why you expect the best value from G-E fluorescent lamps. For free booklet, "Facts About Rapid Start", write to General Electric, Dept. 166-EC-2, Nela Park, Cleveland 12, Ohio.

*REG. U. S. PAT. OFF.

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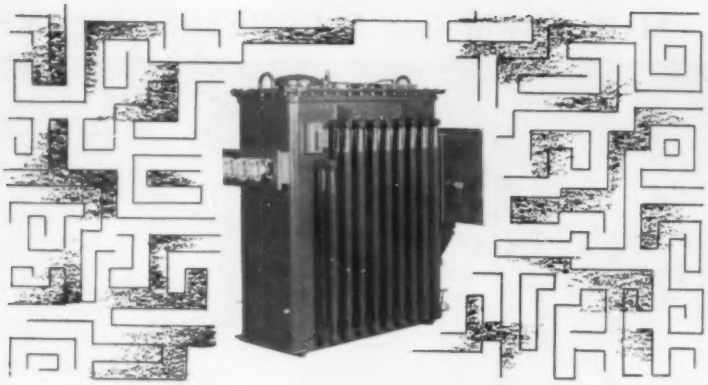
GENERAL ELECTRIC



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An original ABOLITE idea—starts automatic air circulation around lamp and through ventilator slots—expels dust and dirt. Lamp necks stay cooler to provide longer lamp life.

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ABOLITE Protecto-Shield protects these new industrial lamps and eliminates costly lamp breakage resulting from falling objects, water dripping down on hot lamps and other accidental causes.

Sturdy, one piece construction; designed for easy wiring and quick removal without arcing. Lifetime porcelain enamel finish seals the Protecto-Shield against corrosion and rust. Twin units are available for use in combination mercury and filament lamp systems. Available with slotted neck ventilating construction and All-White inside and outside finish. Ask your wholesaler for complete details.

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Famous ABOLITE All-White lifetime Titanium porcelain enamel finish floods *more brilliant light*, provides greater lighting efficiency. Smooth as glass, inside and outside. Resistant to fumes, weather. Easier to clean, less maintenance.

WHITER THAN WHITE ABOLITE *Lighting*

THE JONES METAL PRODUCTS CO. • West Lafayette, O.

how to safeguard such hazards. The mere replacing of a lamp may result in a shock if one end of the lamp is inserted in the high-voltage end of the fixture when that lampholder is alive provided the person inserting the lamp has his hand on the other terminal and is grounded. This hazard was recognized several years ago by the provisions of Section 4183 which requires such equipment to be designed that there will be no exposed live parts when lamps are being inserted, are in place, or are being removed. At the present time the Code recognizes under this provision of Section 4183 voltages in dwelling occupancies not in excess of 1000 volts. It does not however feel that higher voltages should be used, and so expose most of the members of the family, including inquisitive Son Johnny, to the resultant hazards.

I believe there is a distinction in the hazard presented by oil burner equipment and television. Such equipment usually is maintained by competent people and the fellow who would not hesitate to change a lamp or tinker with a fixture would in many cases hesitate to play around such equipment. —B.A.McD.

Overcurrent Protection

Q. *If a panelboard is completely equipped with circuit breakers of 15- and 20-amp ratings, is it necessary to provide overcurrent protection ahead of these individual breakers when the total rating of the board is in excess of 200 amperes?*—M.T.

A. While it would no doubt be an excellent practice to provide overcurrent protection ahead of a panelboard made up of circuit breakers, paragraph b. of Section 3883 specifically states that panelboards equipped with snap switches rated at 30 amperes or less shall have overcurrent protection not in excess of 200 amperes ahead of the switches and inasmuch as it does not provide a similar requirement for a panelboard made up of circuit breakers, I do not feel that the Code would require such protection. —G.R.

Branch Circuit Common Neutral

Q. *A lighting panel contains 38 two-wire lighting circuits, multibreakers for each hot leg. The system is three phase four wire*

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ONLY 75 LBS. BUT PACKED WITH *Power*

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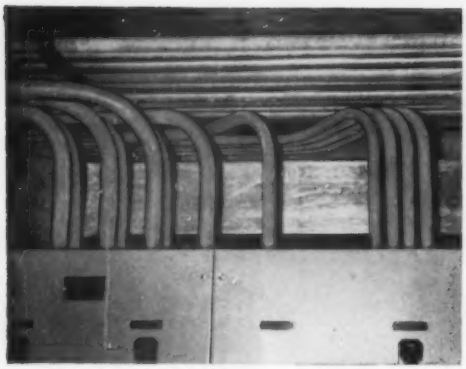

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Milwaukee

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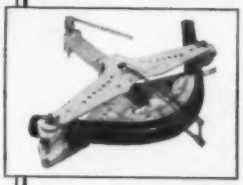

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Completely redesigned—lighter and stronger—solid copper body and tongue for highest conductivity, heavy hex-head screw, extra thick thread plate. Available in 5 sizes for wire sizes from No. 14 to 500 MCM Write for Bulletin.

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ELECTRICAL FITTINGS FOR WIRE and CABLE

WRITE FOR BULLETIN ON S-O TYPE LUGS

grounded neutral. The circuit conductors are run from panel in two groups. Half of the ungrounded wires in one conduit, the other half in another. The neutral, a No. 6, runs from a circuit breaker ahead of the panel to the neutral bar of the panel, thence through one of the above conduits. The other conduit has no neutral.

All of the above conductors run about 100 feet to a large junction box. Ungrounded conductors are spliced to conductors from the fixture circuits. The No. 6 neutral connects to an insulated bar within a box (copper bar insulated from the box). All of the individual grounded circuit wires are also connected to this bar.

Neutrals of equal size from six other panels connect to this same bar with an equal number of grounded individual circuit conductors.

Is it a violation to run the neutral in one conduit and not the other from various panels?

Is it a violation to run the seven neutrals to the bar in junction box as mentioned above?—J.F.

A. I am assuming the circuits are all final branch circuits running from this panelboard.

The use of a common neutral for branch circuits is not recognized by the present code in interior wiring systems. This is a code violation. The 1937 code was the last code which specifically recognized the common neutral for interior wiring of branch circuits.

The neutrals should be run in both conduit lines in such a manner as to insure a balanced electrical field in each conduit line. The circuits are run unbalanced in the above description and they will cause inductive heating of the conduit and wires.—B.Z.S.

Supporting Vertical Lead Covered Conductors In Raceways

Q. *Would the supporting of vertical runs of lead covered cables be covered by the requirements of Section 3014?*—W.E.D.

A. The present Code does not differentiate as to the different types of sheathing, etc. It is possible that certain types of lead sheathed cables may not be adequately supported by any of the methods outlined and it is hoped that this question will bring forth some factual data from our readers supporting the need for some supplementary requirements covering lead sheathed cables.—B.Z.S.

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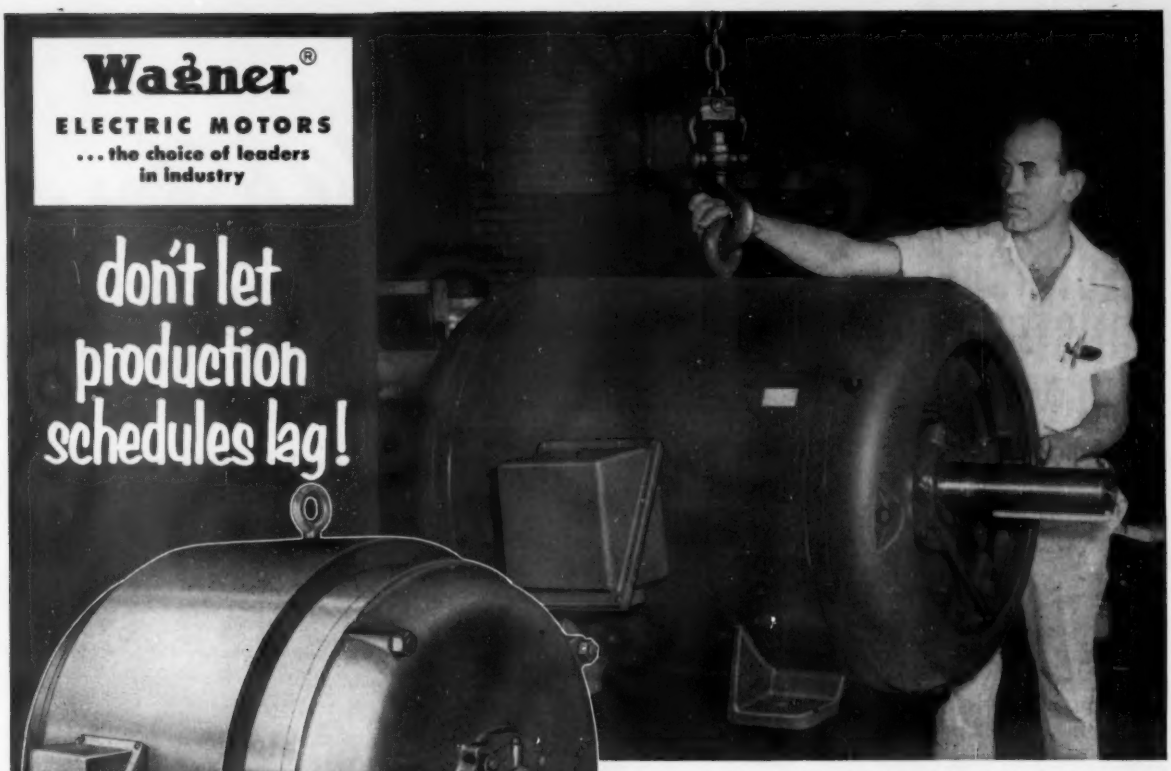

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assure continuity of motor operation

The Wagner line of general-purpose polyphase squirrel-cage motors, built for rugged industrial service, includes a "family" of open protected-type ratings through 400 horsepower. These motors are protected by a heavy steel frame, with ventilating openings at the bottom only, and by endplates of drip-proof design.

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M54-9

Announcing . . .

ELECTRICAL CONSTRUCTION AND MAINTENANCE Lighting Competition

Lighting Competition For Electrical Contractors is being sponsored by ELECTRICAL CONSTRUCTION AND MAINTENANCE to provide wide industry recognition for sales initiative and application of modern lighting technology by electrical contractors . . . and to stimulate interest in the expanding opportunities for lighting progress.

A total of 18 awards will be given for those entries which are considered best by an independent board of three judges. The following have accepted appointment to the board of judges:

Thomas Smith Kelly, Chairman
Lighting Consultant
Thomas Smith Kelly Lighting, Inc.
New York City

Thomas F. Coghlan
Illuminating Engineer
Public Buildings Services
General Services Administration
Washington, D. C.

C. L. Crouch
Technical Director
Illuminating Engineering Society
New York City

Entries will be judged on sales effort, practical or aesthetic customer benefits, effective use of industry aids, lighting adequacy and design and artistic appearance.

Competition closes midnight, December 1, 1954.

Winners will be publicly announced as soon thereafter as the judging can be completed.

CONTEST RULES

I. WHO MAY COMPETE:

Any individual who is either the owner or full-time employee of a regularly established electrical contracting firm may compete for an award.

II. WHAT IS TO BE SUBMITTED:

Each Entry shall cover one or more of the following:

(1) A lighting solution for a single specific visual requirement.
(2) A lighting installation for a specific area, large or small.
(3) An overall lighting installation for an entire building, project or general area.

Lighting installations eligible for Entry include:

(1) Store interiors
(2) Schools and offices
(3) Industrial buildings
(4) Residences
(5) Floodlighting
(6) Miscellaneous: banks, museums, libraries, etc.

III. HOW, WHEN, AND WHERE ENTRY IS TO BE SUBMITTED:

To be eligible for an award consideration, each Entry must be submitted in an Official Entry Folder, bearing an official registration number, which may be secured by writing to

Lighting Competition Chairman
Electrical Construction and Maintenance
330 West 42nd Street
New York 36, New York

To be eligible for award consideration, a competition Entry must be postmarked not later than midnight, December 1, 1954 and must be received by December 10, 1954.

IV. GENERAL REQUIREMENTS AND CONDITIONS CONCERNING ENTRIES:

(1) To quality for Entry in the competition lighting installations must have been completed on or between August 1, 1953 and December 1, 1954.
(2) To be considered in the competition, each Entry must be submitted by an individual who is either the owner or a full-time employee of a regularly established electrical contracting firm.
(3) Installation, in order to be eligible for competition, must have been initiated by the electrical contractor or by a full-time member of his firm. (Lighting installations initiated by other than electrical contractors or their full-time employees are not eligible for Entry in this competition. However, installations on which the electrical contractor engaged the sales and/or engineering services of electrical distributors, lighting equipment manufacturers, electrical utility companies or others are not disqualified.)
(4) A participant by submitting an Entry agrees to be bound by all the rules of the contest. No Entry will be returned. Upon submission, each Entry and the contents and ideas therein become the property of Electrical Construction and Maintenance which shall have the exclusive right to make unlimited use, in whole or in part, of the same.

V. AWARDS:

Entries will be judged on the following considerations: Sales effort, practical or aesthetic customers' benefits, effective use of industry aids, lighting adequacy and technical design in engineering features, artistic appearance. Awards in the numbers and amounts as listed below will be made as determined by a Board of Judges.

18 AWARDS

(1) 6 First Awards, each $100.00 in cash, an Award Certificate, publication of winning installation in Electrical Construction and Maintenance, and

$1350 in awards for the best lighting installations initiated and sold by electrical contractors

. . . LIGHT'S DIAMOND JUBILEE

for Electrical Contractors

LIGHTING COMPETITION FOR ELECTRICAL CONTRACTORS

Eighteen Awards

First, Second and Third Awards For Each Of The Following Types Of Lighting Installations completed between August 1, 1953 and December 1, 1954.

1. *Stores*—all interior sales areas.
2. *Schools and Offices*—classrooms, private and general offices, drafting rooms, conference rooms.
3. *Industrial*—factories, warehouses, production and assembly areas, yard lighting, protective lighting, garage repair shops, storage, and other typical industrial areas.
4. *Residential*—entire house or any parts thereof, including exterior and garden lighting.
5. *Floodlighting*—monumental, recreational, spectacular, and utilitarian, including street lighting and spectacular decorative outdoor lighting for holiday or Light's Diamond Jubilee celebrations.
6. *Miscellaneous*—banks, museums, libraries, hospitals, hotels, churches, theatres, restaurants, auditoriums, gymnasiums, lobbies, reception rooms etc., not otherwise classified.

AWARDS

First Awards—Each $100.00 in cash, an Award Certificate, publication of winning installation in ELECTRICAL CONSTRUCTION AND MAINTENANCE, and 1000 reprints of published winning entry.

Second Awards—Each $75.00 in cash, plus an Award Certificate.

Third Awards—Each $50.00 in cash, plus an Award Certificate.

1000 reprints of the published winning entry.

(2) 6 Second Awards, each $75.00 in cash, plus an Award Certificate.

(3) 6 Third Awards, each $50.00 in cash, plus an Award Certificate.

The selection of Award Winners will be made from all entries. In the event of ties duplicate awards will be made.

VI. ANNOUNCEMENTS OF AWARDS:

The names of all Award Winners will be announced as soon as possible after the close of the competition.

VII. The decisions of the Board of Judges with respect to awards and all other competition matters are final and binding on each participant.

VIII. The competition and awards are subject to all applicable local, state, and federal laws and regulations.

★ ★ ★

ELECTRICAL CONSTRUCTION AND MAINTENANCE

A McGraw-Hill Publication

330 West 42nd Street
New York 36, N. Y.

Lighting Competition Chairman
ELECTRICAL CONSTRUCTION AND MAINTENANCE
330 West 42nd Street
New York 36, New York

Dear Sir:

Please send me an Official Rules and General Information folder and ..... copies of the Official Entry Application forms.

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Company .....

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City .....Zone.....State.....

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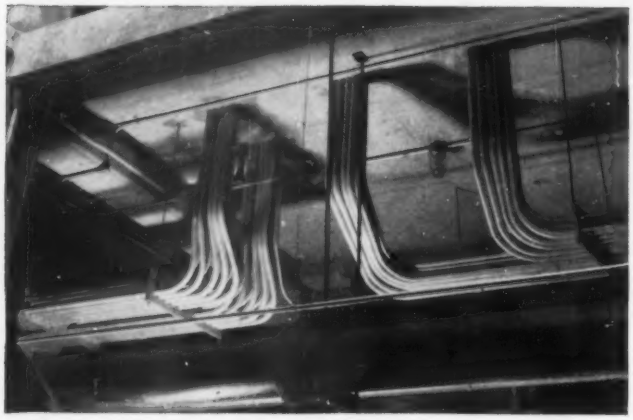

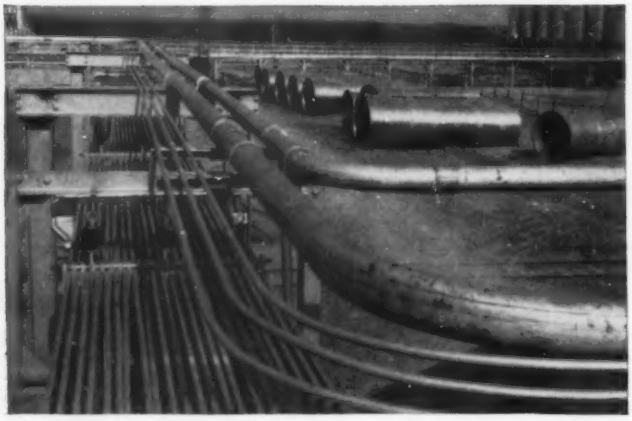

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In The News

SEWA Meets In Atlanta

A bright future for business in the South was seen by NECA National President D. B. Clayton in addressing the fourth "Industry Day" of the Southeastern Electrical Wholesalers Association held Jan. 14-15 in Atlanta.

Mr. Clayton said that the South is moving ahead rapidly in industrialization, and with this trend is an increased volume of business and opportunities.

He saw a need to increase the income of the middle income group to provide additional purchasing power.

In discussing the problems of contractors in labor relations, Mr. Clayton said that a great deal of effort is needed to convert the attitude of union labor members from one of union thinking to thinking as a businessman. He said this was difficult because of the government policy over the past Democratic administrations.

Mr. Clayton told the SEWA that he did not believe the policy of price cutting, with some wholesalers cutting even below cost, was in the best interest of the industry. He said his belief was that service to customer should be paramount to insure industry progress.

His discussion of the problems of the electrical contractor gave the manufacturers and wholesalers present at the meeting a better understanding of the operations of the contractor. Mr. Clayton pointed to the progress made by NECA and the programs now under way to stimulate business.

During the discussion of the bill now before Congress to prevent "job shopping" Mr. Clayton declared that many government agencies do not want any restrictions placed on their specifications. He said that NECA is supporting the Federal Construction bill and sees in it a method of eliminating many unsound practices.

Of special interest to electrical contractors is the fact that wholesalers again brought pressure to bear on the manufacturers for better labeling and packaging of products. Also the elimination of many odd sizes and reduction in the number of sizes of various products. The demand was for standardization for more economical operation. Simplification of existing lines of products would be a step forward, was the general opinion.

Bright prospects for 1954 were seen by Lothair Teetor, Assistant Secretary of Commerce for domestic affairs. He declared that the Department of Commerce does not believe that the flow of pessimism from some quarters can be supported by a correct analysis of the facts.

NATIONAL PRESIDENT D. B. Clayton of NECA, and president of Electrical Constructors, Birmingham, Ala., left, is greeted by President-Elect B. F. Buchan of Southeastern Electrical Wholesalers Association fourth "Industry Day" meeting held Jan. 14-15 in Atlanta, Ga.

Mr. Teetor said that one of the most encouraging factors for business is the change in government attitude toward business.

The administration does not believe in master planning, Mr. Teetor said, and added that it does believe in the absolute minimum of regulations and controls on business. "They have the absolute conviction that American business can and should be responsible for its own success and growth."

Dramatic Skits Tell AW-PL Story to Builders

For the first time in the history of the National Association of Home Builders, Adequate Wiring and Planned Lighting were part of its formal national convention program. An afternoon general session was devoted to these subjects at the 10th Annual NAHB Convention and Exposition in Chicago's Conrad Hilton Hotel January 17-21.

Instead of routine formalized talks and addresses, the National Adequate Wiring Bureau and the Electrical Industry Lighting Committee (represented by General Electric, Sylvania, Westinghouse and Edison Electric Institute) resorted to highly effective dramatic stage presentations to emphasize merchandising features of adequate wiring and planned lighting.

A three-act comedy skit took home builders into an average two-year old, inadequately wired home; showed them the frustrations of a young family struggling against lack of outlets and electrical capacity. Narrator Carl T. Bremicker, vice president, Northern States Power Company, Minneapolis, prefaced each act with pertinent running commentary as the skit portrayed the losing battle against: (1) the growing outlet octopus in the modern bedroom; (2) the dilemma of TV or air conditioning—but not both—in the living room; and (3) the limitations imposed by too small a service on labor saving appliances in the laundry.

All this could be avoided, Bremicker pointed up, if the home builders would only: (1) permit installation of sufficient outlets where needed; (2) consider larger service entrance conductors, service switch and more branch circuits; and (3) consider the use of 120/240-volt, 3-wire circuits which provide twice the capacity with only 50% more copper.

Builders who have the physical and psychological well-being of home owners at heart could well ponder the reaction of customers who face similar situations—and they were by no means exaggerated—after purchasing a home. In fact some builders already have recognized the problem and are incorporating adequate wiring in their new homes. Here is what a few are doing in the following cities:

South Bend, Indiana—Andrew S. Place, Place & Company, is using 110/220-volt, 3-wire circuits in his homes ($13,000 class). He runs one 3-wire circuit from the panel each way around walls of the house to serve the living room and bedrooms; provides 220-volt circuit at each outlet so future addition of a room air conditioner will involve only a change of receptacle and change of connection at the outlet. He saved so much by using this system that he could increase service from 60 to 100 amperes. Chief Electrical Inspector H. E. Harrison of South Bend sold Place on this idea and he now uses it in all homes he builds.

Omaha, Nebraska—Clair M. Wilson, Wilson & Johnson Co., is building a 400-home project—all AW Certified. He believes the public is learning to appreciate good wiring as much as "gingerbread" features of homes. A home with enough circuits and electrical capacity for future—he calls it "expandable wiring system"—makes a big hit with home buyers. He found

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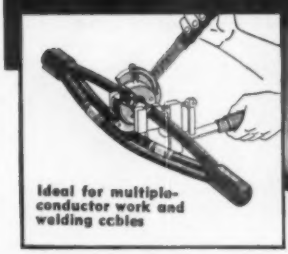

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BETTER WIRING HUDDLE FINDS (L to R) Carl T. Bremicker, Northern States Power Co., Minneapolis; O. C. Small, secretary, National Adequate Wiring Bureau; and Clair M. Wilson, Omaha, builder discussing 100-ampere services at Home Builders Convention in Chicago. Wilson uses them in his homes.

it only cost about $18 more per home to put in a 100-ampere service compared to normal 60-ampere size.

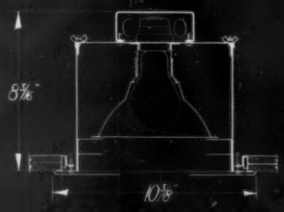
Pueblo, Colorado—John Bonforte, residential developer and builder, is 100% for Adequate Wiring; is now working on a 10,000-home project ($9,600 to $15,000 range, two to four bedroom, two-bath type) all of which will be Certified. His original wiring design was so close to standard that it cost only about $15 per home to gain Certification. Bonforte credits electrical contractor Simon Halle with selling him on all out AW Certification for his homes.

The "Builders Jubilee With Light," a 50-minute stage presentation with a professional cast, dramatized a home builder's dream of adding more merchandising features to his homes. Planned lighting in each room was the answer, he learned. Following his dream, he immediately decided to change his specifications to feature better lighting in his homes—an addition he was confident would help him sell his homes more easily to a public looking for more value per dollar.

That home builders are recognizing, more and more, the value of good wiring and lighting was evident at the convention. The interest shown in electric heating exhibits, room and central air conditioning units, wiring devices and materials, major electrical appliances was a convincing sign. Home buyers are going to want to use these labor saving and convenience appliances. Unless the wiring systems can take the load, home builders are going to face the situations so dramatically presented in the electrical session. Many builders already are on the better wiring bandwagon. It's a good possibility that definite NAHB electrical recommendations will be made to member builders in the near future.

SPOT LIGHTING WITH CURTIS

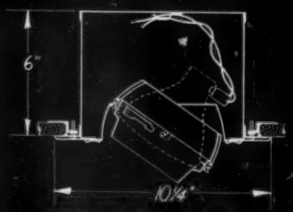
"VARI-SPOT"



CATALOG No. 2246

Curtis "Vari-Spot" is a shallow recessed downlight, utilizing one 100-watt inside frosted incandescent lamp. It is designed for use in residential and commercial interiors. An adjustable Alzak aluminum reflector permits the diameter of the circle of light to be controlled and changed as desired. Decorative holes in the finishing ring provide an attractive light pattern at the ceiling.

"PUNCHY"

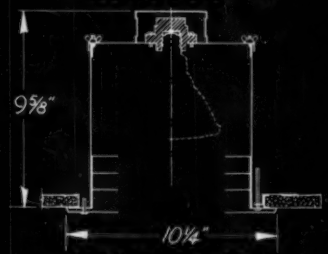


CATALOG No. 2240

Curtis "Punchy", is a shallow recessed adjustable downlight utilizing one PAR-38, Side Prong 150-watt projector spot or flood lamp. It is designed to provide punch lighting for counters, displays, show windows and other areas in store interiors.

"Punchy" features an exclusive aluminum gimbal ring which permits adjustment of the lamp to any angle 0° to 35° from the vertical, and 0° to 360° horizontal.

"SPOTTY"



CATALOG No. 2244

Curtis "Spotty" is a shallow recessed fixed downlight utilizing either one PAR-38 or R-40 screw base 150-watt spot or flood lamp. It has wide application for accent, supplementary and general lighting.

Three horizontal steel baffles, an integral part of each unit, are designed and positioned to provide an exceptionally low-brightness incandescent unit at normal viewing angles.

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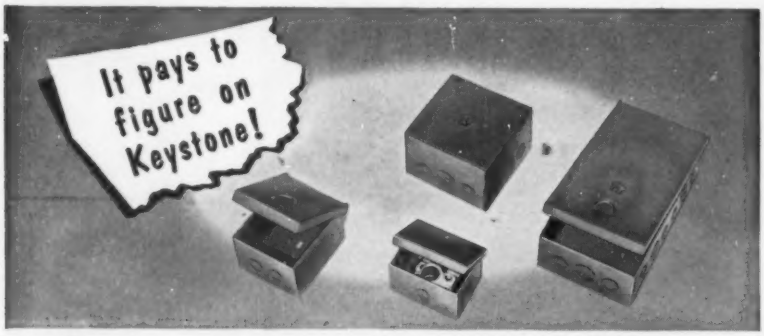

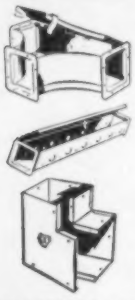

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Midwest Electrical Council Votes Dissolution

The Midwest Electrical Council, Inc., Minneapolis, Minn., ceased to exist January 31, 1954, after 20 years of service to electrical contractor organizations in the upper Midwest area. Voluntary dissolution proceedings were instituted following a unanimous vote of the Council membership.

Moreau Bailey, Albert Lea, Minn., contractor, was appointed Liquidating Receiver to wind up the affairs of the corporation.

The Council, organized in 1933, was the central service organization of the following sponsoring groups: Minneapolis Electrical Contractors Association; Minnesota Electrical Association, Inc.; St. Paul Electrical Contractors Association; North Dakota Electrical Contractors Association; South Dakota Electrical Contractors Association; Iowa Electrical Association; Electrical Contractors Association of Washington.

During the war and postwar years the Council offered invaluable service to its member groups by acting as a clearing house for information on critical materials, priority regulations and interpretations, controlled materials plan and other wartime controls affecting the electrical construction industry. It also made available simplified, standard bookkeeping systems, standard business forms and acted as a central agency for electrical trade books.

Present plans indicate that distribution of forms, books, manuals and services formerly performed by the Council will be taken over by the Minnesota Electrical Association.

Over 5,000 At AIEE Meeting

The Hotel Statler, New York City, was the scene of the 1954 Winter General Meeting of the American Institute of Electrical Engineers, January 18 to 22. During the five day conclave, the latest advances and discoveries in electrical engineering were reviewed by attending members.

Highlight of the meeting's opening session was the award of the Edison Medal to John F. Peters, Westinghouse Electric Corp., consulting engineer. Elgin B. Robertson, President of AIEE, made the presentation. At this general session, Admiral Harold G. Bowen, executive director of the Thomas Alva Edison Foundation, delivered the opening address on "The Genesis of the Electric Light and Power Industry." The program for the meeting included 95 technical sessions

and symposiums, during which 410 papers on almost every aspect of electrical engineering were presented by leaders in more than a score of branches of the profession. Subjects ranged from the behavior of light waves to atomic propelled ships and latest developments in the transmission of huge blocks of electric power for use in atomic energy plants.

Two sessions were devoted to the application and economics of various types of lighting systems. The importance of effective lighting maintenance and the advantages of group lamp replacement were stressed. Operation of all components of any lighting system within design limits of the equipment was cited as a factor often overlooked in lighting maintenance. Cases of actual maintenance programs were also presented at these sessions of the committee on Production and Application of Light.

William E. Coleman and Harold Frostick of the United States Steel Corp. presented a conference paper on "Electrical Grounding and Cathodic Protection at the Fairless Works." They described the use of steel instead of copper in the grounding system at the plant. This use of steel was adopted as part of a program to minimize underground corrosion.

In the field of rotating machinery, considerable coverage was given to the operation and application of motors. One paper evaluated motor losses and motor line currents in the operation of three-phase induction motors on unbalanced voltages. Other discussions covered single-phase operation of a three-phase motor with a simple static phase converter, a method of determining induction-motor speed-torque-current curves from reduced voltage tests, and analysis of motor winding insulation and ionization effects.

In a paper on coordinated fuse protection for low-voltage distribution systems in industrial plants, the following point was emphasized: "Until the advent of the dual-element fuse coordinated fuse protection for low-voltage distribution systems was virtually impossible because the time-current characteristic of the non-renewable and renewable fuse did not match the safe time-current characteristic of the circuit. Even short circuit protection on ac distribution systems was doubtful because of the lack of data on the interrupting capacity of non-renewable and renewable fuses. The greatly enhanced time-lag characteristic of the dual-element fuse makes it possible to protect the low-voltage system against dangerous overloads and its interrupting capacity assures satisfactory performance under fault conditions."

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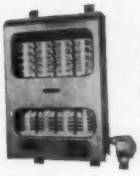
available from 10,000 to 45,000 watts (34,150 to 153,675 btu). Adjustable louvers permit directing heat into working zone. Model 14-10 illustrated.

COMBINATION PORTABLE

and Suspension type. Available from 1500 to 7500 watts (5,122 to 25,613 btu). Adjustable louvers permit directing heat into working zone. Model AN-30A illustrated.



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Inspectors Set Electrical Week Date

For the first time in the history of the electrical industry, a National Electrical Week will be sponsored by the International Association of Electrical Inspectors. The time: the week of October 18, 1954 (to coincide with Light's Diamond Jubilee, Oct. 21st). The place: every city, town and hamlet in the United States and its possessions. The cast: every member of the vast electrical industry.

Official announcement of the proposed program was made at the 24th Annual Meeting of the Illinois Chapter, IAEI held at Chicago's Hotel Sherman, Jan. 14-15. Original decision to sponsor such a nationwide observance was made by the Executive Council, IAEI, at the Silver Jubilee Convention last year. The move was based on the unusual success of Electrical week promotions held in the states of Washington and Michigan.

The objectives of a National Electrical Week were outlined at this kick-off meeting by B. A. McDonald, Rochester, N. Y., international president, IAEI.

Herbert E. Cook, Detroit, IAEI National Electrical Week Committee Chairman, announced the date of the week-long observance and briefly outlined the organizational progress to date. Working closely with him on the IAEI Committee are: A. J. Riopelle (Western Section), Detroit; Leon M. Guidara (Southwestern Section), Los Angeles; R. E. Ward (Southern Secton), Kenton, Tennessee; Capt. S. E. Sanislo (Northwestern Section), Seattle; and E. A. Brand (Eastern Section), Buffalo, New York. On the Ex-officio Advisory Committee are: C. L. Smith, Chicago; B. A. McDonald, Rochester, N. Y., and S. R. Todd, Chicago.

NISA News

New York Metropolitan Chapter met at the Hotel Shelburne November 19th with 46 persons present. In addition to committee reports the group saw an educational motion picture, "The Inner Man Steps Out."

• • • •

Convention plans were discussed at the December 14th meeting of the Great Lakes Chapter at Detroit's Rackham Building. NISA Executive Secretary Fred B. Wipperman was among those present who also heard Webster Bowler of United Motors Service discuss motor manufacture. The group viewed a motion picture showing the manufacturing of Delco Motors.

New England Chapter held its regular meeting at the Hotel Bradford on December 10th. After cocktails, dinner, and entertainment by their own vocalist "Mac," the meeting was called to order by their president, Ed Kolhonen.

The meeting was then turned over to Dave Sandman, who showed slides taken on his European trip.

• • • •

At the November meeting of the Quaker City Chapter they had the pleasure of having National Secretary Fred Wipperman with them. His talk covered several items of interest—one of which was the proposed plan to use a blanket insurance coverage written for the entire NISA organization and subscribed to by the individual shops.

• • • •

General Cable Corp. has relaxed its requirements for return of magnet wire reels in good condition held longer than 12 months, and NISA members are advised by National Headquarters to contact their local General Cable representatives for current instructions.

Until recently, the corporation had limited full credit refunds to reels held less than 12 months and had deducted 5% per month from its refund credit for reels held for longer periods. The practice is a departure from established policy of magnet wire suppliers.

• • • •

Louisville Chapter met Dec. 2nd at the Mayflower Restaurant with 16 persons present. After a brief meeting, the group participated in a Christmas party arranged by Owen Gollar Jr. and George Ruf.

• • • •

Busy with plans for the NISA exhibit at the Plant Maintenance Show Jan. 25-28 at Chicago's International Amphitheater, Central District Chapter took time out Dec. 10 to re-elect its present officers for the coming year. They are: president, Glen F. Glave, Chicago Electric Co; vice-president, F. H. Westphal, Westphal & Co., Janesville, Wis; secretary, Paul Martin, Northwestern Electric Co; treasurer, H. W. Reeve, Inland Industrial Electric Service Co; directors (three years) W. C. Luebker, Hyre Electric Co. and G. E. Mandell, Rainbow Electric Co. Evanston. Except where noted, all are from Chicago firms.

John Merriell, chief application engineer, Fairbanks Morse & Co. (Freeport Works) discussed the new NEMA frame program and how it would affect motor manufacture and repairs.

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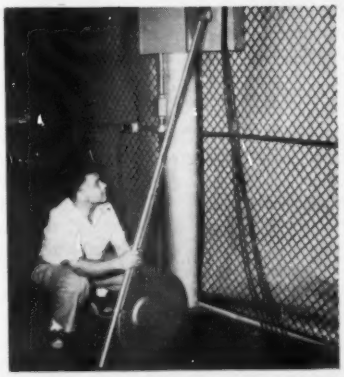

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NISA's New England Chapter has a motion picture, "Selling," available for use by other chapters for transportation costs and a small charge. Interested chapter program chairmen should write Bernard Rosenberg, secretary, New England Chapter of NISA, 883 Boylston Street, Boston 16, Mass.

• • • •

Attractive two-color posters 11½ by 17 in. announcing the 1954 Award Contest were mailed to all members Nov. 17th for display in shop and office bulletin boards.

Rules are the same as in previous years. Entries may be submitted by photograph, sketch, written description or blueprint with all personal and business identification removed. Such identification should be attached on a separate sheet of paper or letterhead.

• • • •

Twenty-two persons were on hand when Greater Cleveland Chapter met September 21st at the Allerton Hotel, Cleveland, holding a discussion of warranty service contracts. No specific chapter action was deemed necessary. Tony Woods and Dallas Meyers, Dow Corning Corp., lectured the group on silicone insulations.

• • • •

New Orleans Chapter held its regular monthly meeting at Irwin's Restaurant Oct. 27th with 11 persons, including five guests, present. B. Gerber, United Motors Service, showed the group movies of the manufacture of electric motors and refrigeration compressors.

NISA's Board of Directors, meeting in Atlanta Oct. 25-26 approved a new price of $2.00 for extra copies of the Membership List, a price more accurately reflecting the true cost of the Association's directory. The new price applies to members and nonmembers and became effective on December 1st.

• • • •

Great Lakes Chapter's 1954 NISA Convention Committee met November 23rd at Spaulding Electric Co., Detroit, to discuss convention entertainment, technical papers and forums. Members of the committee attending the meeting included C. E. Smith, assistant general chairman; Bob Turner, program committee chairman; Walter Cohen, president of Great Lakes Chapter; Cecil Medsker, Otto Werner, Ed Burke, Grant Weeks, George Glenning and Charles Johnson.

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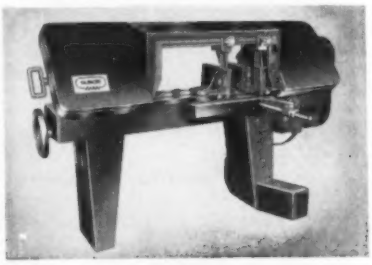

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DATES AHEAD

Tenth Annual Adequate Wiring Conference—LaSalle Hotel, Chicago, Ill., February 25-26.

National Electrical Manufacturers Assn. — Edgewater Beach Hotel, Chicago, Ill., March 8-11.

Power and Communication Contractors Association — Ninth Annual convention, Edgewater Beach Hotel, Chicago, Ill., March 8-11.

Electrical Industry Convention and Trade Exposition—St. Paul, Minn., March 21-24.

National Power Show—Hotel Sherman, Chicago, Ill., March 23-27.

Electrical Industry Show—Shrine Exposition Hall, Los Angeles, Calif., April 1-3.

Edison Electric Institute—Sales conference, Edgewater Beach Hotel, Chicago, Ill., April 5-8.

Illuminating Engineering Society—Regional Conferences: Southern—Roosevelt Hotel, New Orleans, La., April 8-9; Southwestern—Rice Hotel, Houston, Texas, April 11-13; Inter-Mountain — Denver, Colo., April 15-16; South Pacific Coast—Museum of Art, San Francisco, April 19-20; Pacific Northwest—Benjamin Franklin Hotel, Seattle, Wash., April 22-23; Canadian—King Edward Hotel, Toronto, Ont., Canada, April 28-30; Great Lakes—Sheraton-Cadillac Hotel, Detroit, Mich., May 3-4; Midwestern — Jefferson Hotel, St. Louis, Mo., June 17-19.

American Society of Tool Engineers' Industrial Exposition — Convention Center, Philadelphia, Pa., April 26-30.

Welding & Allied Industry Exposition—Sponsored by American Welding Society, Memorial Auditorium, Buffalo, N. Y., May 5-7.

Electrical Manufacturers Representatives of New England—Trade Show, Mechanics Building, Boston, Mass., May 5-7.

Chicago Electrical Industry Show — Conrad Hilton Hotel, Chicago, Ill., May 10-12.

National Fire Protection Association—58th annual meeting, Statler Hotel, Washington, D. C., May 17-21.

Edison Electric Institute—Annual convention, Atlantic City, N. J., June 1-3.

National Association of Electrical Distributors—Annual convention, Atlantic City, N. J., Week of June 6.

National Industrial Service Assn. — Annual convention, Hotel Statler, Detroit, Mich., June 13-16.

N. Y. State Electrical Contractors and Dealers, Inc. — Annual convention, Saranac Inn, Saranac Inn, N. Y., June 28-July 2.

Western Plant Maintenance Show and Conference — Pan Pacific Auditorium, Los Angeles, Calif., July 13-15.

Illuminating Engineering Society — National Technical Conference, Chalfonte-Haddon Hall, Atlantic City, N. J., September 12-16.

International Association of Electrical Leagues—Bellevue Stratford Hotel, Philadelphia, Pa., September 29-October 2.

National Electronics Conference, Inc. —Hotel Sherman, Chicago, Ill., October 4-6.

Eastern Canada All Electrical Show—Show-Mart Exhibition Hall, Montreal, Quebec, Canada, October 6-10.

National Electrical Manufacturers Assn.—Haddon Hall Hotel, Atlantic City, N. J., November 8-11.

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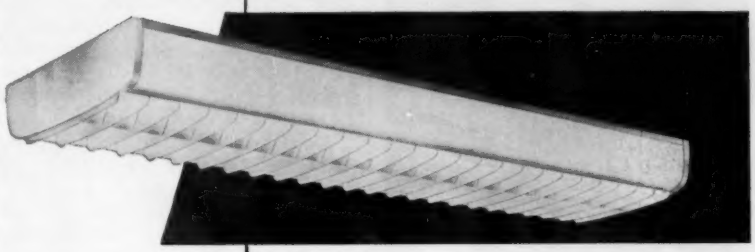

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4 & 8 FT. LUMINAIRES FOR INDIVIDUAL OR END-TO-END MOUNTING

- The 2-lamp Garfield is a gracefully styled luminaire with long, low lines that give it a "built-in" look. Its 3⅞" depth makes it ideal for surface mounting on low ceilings—yet it is equally handsome when pendant mounted.
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It gives complete specifications, dimensional drawings and engineering data for the Garfield.

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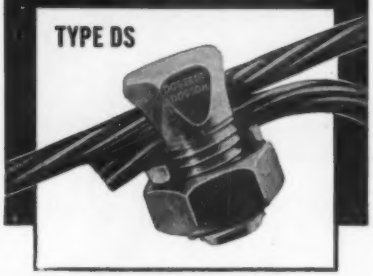

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SINCE 1904

Wohlgezon Heads Chicago Contractors

A. A. Wohlgezon, Builders Lighting Fixture Company, is the new president of the Cook County Electrical Contractors Association in Chicago. He was formally inducted into office January 18 at CCECA's Sixteenth Anniversary and Installation Dinner Dance held at the Chez Paree.

More than 500 members, suppliers and guests saw Wohlgezon and his official group take over the reins from retiring president Abe Sluis. Other officers are as follows: vice president —L. Matson, Active Electric Co.; secretary—A. L. Simons, Clark Electric Co.; treasurer—Erwin Kaufmann, Kaufmann Electric Company.

Directors include: E. H. Wigdahl, Wigdahl Electric Co.; Ed Wozniak, Ed's Electrical Service; G. A. Rafel, G. A. Rafel & Co.; M. H. Keller, D. D. Electric Co.; W. Veldhouse, Service Electric Co.; B. Braverman, Almart Electric Co.; J. Kunst, Jr., Principle Electric Company.

Wigdahl Heads Home Wiring Committee

Edward H. Wigdahl, president, Wigdahl Electric Company, Chicago, has been appointed chairman of the Home Wiring Modernization Committee of the Electric Association of Chicago. Prime goal of the committee will be to promote upgrading of the wiring in more than one million older homes in the Chicago area. Reliable estimates indicate each of these homes need a minimum of $100 of additional wiring, according to EA reports.

Wigdahl brings to this activity a long and successful background in the electrical field. He has headed his own electrical contracting firm for 33 years; is thoroughly experienced in residential wiring requirements.

To help him in this promotional effort, Mr. Wigdahl selected the following committee members: J. C. Anderson, Westinghouse Electric Supply Co.; H. M. Gibson, Gibson Electric Company; E. M. Nelson, National Electrical Products Corp.; and Walter Wood, Commonwealth Edison Company.

Opening gun of the EA 1954 promotional program for better home wiring was the Chicago Better Wiring Conference at Chicago's LaSalle Hotel on Jan. 21. This served as a springboard for other coordinated projects to come—such as: The Better Wiring Show at the Edison Building, Feb. 1-19; and the Better Wiring Educational Exhibit scheduled for Chicago's Modern Living Exposition, April 3-11.

SLIP-ON GUARD

GETS-A-LITE GUARD and GUIDE

Quickly and Easily Installed by Anyone — No Tools Needed!

- Simply slip GETS-A-LITE GUARD AND GUIDE over the fixture, as illustrated.
- Made of indestructible spring steel wire. Nothing to break, get out of order or replace. Will last indefinitely.
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- GETS-A-LITE GUARD AND GUIDE actually steers lamp into socket, enabling maintenance man to change lamp in 10 seconds!
- Available for 40 watt and 100 watt fluorescent lamps.

Contact Your Electrical Wholesaler, OR

GETS-A-LITE Company—Dept. EC24
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SPERO "HB"
ALUMINUM SHIELDS!!

. . . for the protection of GE R-52 and WESTINGHOUSE R-57 LAMPS.

Protection from moisture assures full lamp life. Supply the best . . . Spero H-B Shields!!

- ★ One piece heavy aluminum spinning affords greater heat dissipation.
- ★ Ventilated.
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- ★ Wire guards available for bottom of units.

SPERO also makes "GUARANTEED" PORCELAIN ENAMEL REFLECTORS... FLOODLIGHTS... VAPOR-TIGHT UNITS... INSULATORS... SWITCHPLATES

THE SPERO ELECTRIC CORPORATION
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Among the Manufacturers

Headquarters Announcements

Minnesota Mining & Mfg. Co., St. Paul, Minn.—Erwin W. Brown, division engineer, Electrical Products Group.

General Electric Co., Bloomfield, N. J.—Philip B. Hoppin, manager of advertising and sales promotion, Air Conditioning Division.

Graybar Electric Co., Inc., New York—R. B. Sayre, vice president.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Robert L. Carlstein, assistant production control manager, West Allis Works; William H. Schrinner, superintendent of material control, West Allis Works.

Southern States Equipment Corp., Hampton, Ga.—Glenn Mitchell, vice president for manufacturing; T. A. Burdeshaw, engineering manager; J. E. Cordell, sales manager, Electrical Division.

Panalarm Products, Inc., Chicago, Ill.—Howard W. Hudson, vice president.

Ward Leonard Electric Co., Mt. Vernon, N. Y.—T. C. Hadden, Jr., purchasing agent.

General Electric Co., Cleveland, Ohio—Roy Lewis Johnson, manager, Financial Dept., Lamp Division.

Pyle-National Co., Chicago, Ill.—F. Lee Davis, manager of industrial sales; Frank M. Currie, supervisor of field sales.

Belgian Electric Sales Corp., New York, N. Y.—Edmond Charles Falleur, chief technical enginer.

Westinghouse Electric Corp., Pittsburgh, Pa.—Latham E. Osborne, executive vice president and member, board of directors; Leslie E. Lynde, vice president, defense products.

Multi-Amp Corp., Harrison, N. J.—Robert S. Beckham, vice president in charge of distribution.

Lau Blower Company, Dayton, Ohio—Ben T. Clark, and Harry Roit, sales representatives, Fan Division.

General Electric Co., Louisville, Ky.—John H. O'Toole, general sales manager, Appliances Company.

Sylvania Electric Products Inc., New York, N. Y.—Herman L. Schreiner, retail sales manager, Lighting Div.

Industrial Fasteners Institute, Cleveland, Ohio—Frank Masterson, president.

General Electric Co., Syracuse, N. Y.—G. H. DeSousa, manager of equipment tool sales, and Milton J. Strehle, manager of marketing administration, Tube Department.

EXCLUSIVE

Each "on-off" cycle can be independently set for any timing from 5 to 60 minutes.

Another **NEW** *Addition*
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INTER-MATIC®
TIME SWITCH FAMILY

SERIES T670—for
Timings of 5 to 60 Minutes

- *Snap-out mechanism*
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FOR THE FIRST TIME . . . a time switch that provides multiple "on-off" cycles—each independently adjustable for settings of from 5 to 60 minutes . . . AND . . . from 1 to 12 "on-off" operations a day—every day! It's the NEW Inter-Matic Series T670 Time Switch.

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Other models available in a complete line.

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HANDIEST... because it's *really* portable. You can use it on the floor on the bench or overhead on existing pipe runs. And — it's easy to roll or carry to the job.

HANDIEST... because you can simultaneously pump and sight the job from any angle . . . assure better bends. Can be hand operated or motor driven.

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Globe Lighting Products, Inc., Broklyn, N. Y.—Ed. Skillman, sales promotion, advertising and merchandising manager.

Square D Company, Detroit, Mich. —Lawrence G. Maechtlen, manager, Western Division, and J. H. Pengilly, chairman, Western Division's Executive Committee.

The Austin Company, Cleveland, Ohio—Harold A. Anderson, vice president and assistant general manager; Allan S. Austin, vice president and general sales manager; W. G. Paton, vice president and secretary.

General Electric Co., Cleveland, Ohio—William S. Baker, manager of tool sales, Carboloy Dept.

Fairbanks, Morse & Co., Chicago, Ill.—Donald L. Harwood, general purchasing agent.

Rockwell Mfg. Company, Pittsburgh, Pa.—F. P. Maxwell, vice president, Power Tool Division.

Acro Manufacturing Co., Columbus, Ohio—Walter F. Rockwell, chairman of the board; F. G. McCloskey, president.

Emerson Electric Mfg. Co., St. Louis, Mo.—Wallace R. Persons, president and director.

American Radiator & Standard Sanitary Corp., Pittsburgh, Pa.—William H. Baker, Jr., vice president, Sunbeam Air Conditioner Division.

The Hoover Company, Chicago, Ill. —Eldred P. Codling, chief engineer, Electric Motor Division.

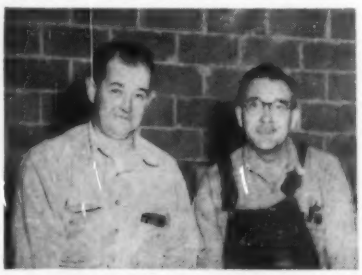
Radiant Lamp Corp., Newark, N. J. —David Forman, industrial sales manager.

Regional Appointments

NEW ENGLAND

General Electric Co., Carboloy Dept.: Harry H. Jason, manager, New England Sales District, office in Wellesley, Mass.

The Electric Storage Battery Co.: John W. Kelly, manager, Boston branch office.



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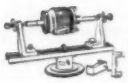

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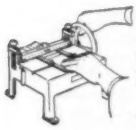

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General Electric Co., Carboloy Dept.; C. W. Powell, manager, Allegheny district, office in Pittsburgh, Pa.

The Ridge Tool Company, Elyria, Ohio—Ralph W. Hamlin, sales representative, New Jersey, Pennsylvania, and Wilmington, Del., succeeding C. O. Hollen, retired.

Graybar Electric Co., Inc.: August Stang, Jr., manager, Allentown, Pa., branch.

Reliance Electric & Engineering Co.: A. W. Bridges and L. W. Kutz, application engineers, Philadelphia district sales office, Ardmore, Pa.; James W. Landers, application engineer, Newark, N. J. branch sales office.

SOUTH ATLANTIC

The Miller Company, Illuminating Div.: Furna E. Lott, agent in the State of Florida.

Reliance Electric & Engineering Co.: C. A. Emmert, application engineer, Baltimore branch sales office.

The Ridge Tool Co.: M. B. Williams, sales representative for Pipe Tool sales in District of Columbia, Maryland, Delaware, Virginia and North Carolina.

Thor Power Tool Co.: Ernest D. Fischer, manager, factory branch office, Atlanta, Ga.

EAST CENTRAL

General Electric Co., Carboloy Dept.: Alfred M. Thomson Jr., manager, East Central District Sales, office in Cleveland, Ohio.

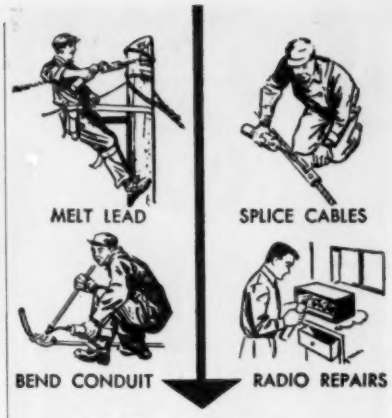
Homelite Corp.; R. J. Marschalk, Chicago District Sales Manager, office in Melrose Park, Ill.

The Pyle-National Company: John H. Devol, district manager, new sales office, Room 707, Railway Exchange Bldg., 80 East Jackson Blvd., Chicago 4, Ill.

Pittsburgh Reflector Co.: Frank P. Schram and Harold R. Berkal, sales engineers, Chicago office, covering Northern Illinois, Wisconsin, Michigan and Indiana.

Electric Regulator Corp.: A. W. Siff, manager, new field engineering office, Chicago, Ill.

Honan-Crane Corp.: Lawrence A. Gerber, sales engineer, office in Day-



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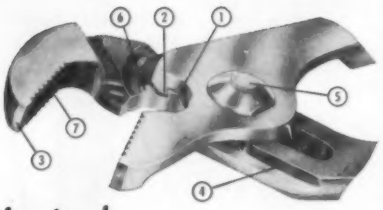

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Minnesota Mining & Mfg. Co.: Richard F. Woelfel, sales manager, Chicago area.

Arrow-Hart & Hegeman Electric Co.: H. J. Fonda, manager, Chicago office, succeeding R. L. Wildauer, retired.

WEST CENTRAL

Electric Service Mfg. Co.: W. E. Erbe, St. Louis Sales Representative, succeeding T. F. McKenna, retired.

Line Material Company: John R. Boots, field engineer, southern Minnesota, office in Minneapolis; Tom D. Williams, field engineer, central Minnesota and eastern Wisconsin, office in Minneapolis; Wilbur R. Coffin, field engineer, western Minnesota and eastern North Dakota, office in Fergus Falls, Minn.; Gerald O. Smith, western North and South Dakota, eastern Montana, and northeastern Wyoming, office in Bismarck, N. D.

Garden City Plating & Mfg. Co., Garcy Lighting: B. L. Cook, representative in Gulf Coast Area of Texas, office in Houston.

General Electric Co., Carboloy Dept.: J. D. Kennedy, manager, South Central sales district, St. Louis.

Graybar Electric Co., Inc.: L. C. Owen, Jr., District Credit Manager at Dallas, Texas.

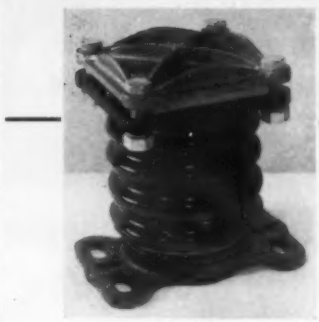
WEST

Day-Brite Lighting, Inc.: Edward L. Peterson, representative for San Diego and southeastern California territory.

Electro Silv-A-King Corp.: George Stallman, district sales manager, Seattle District, serving Washington and Oregon.

General Electric Co., Lamp Division: Donald D. Scarff, manager, Puget Sound Sales District, office in Seattle, Wash.

ALASKA is a place of great concern to Bill Langlais who is handling home-office details on several jobs which Charles A. Langlais Co., San Francisco, is handling up in that North territory.



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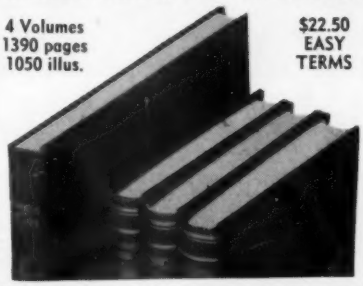

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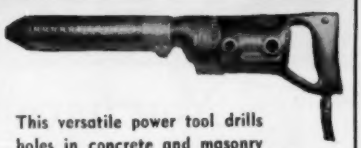

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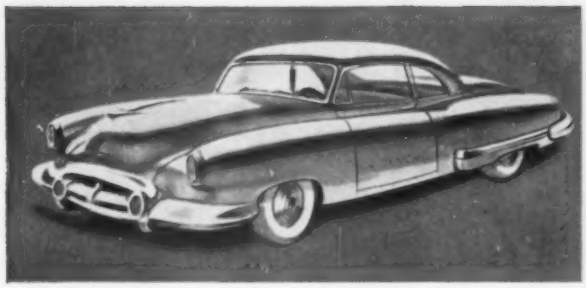

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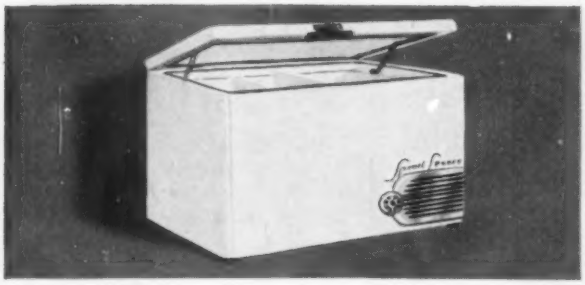

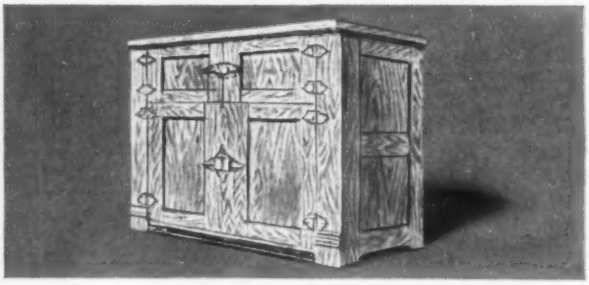

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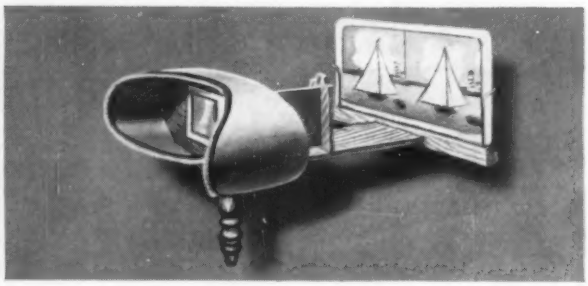

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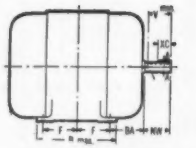
PART I—

Old vs New

NEMA MOTOR FRAME DIMENSIONS

1 to 30 HP

Polyphase Squirrel-Cage Motors—Designs A, B and C
General Purpose, Foot-Mounted—Open Type, 40C; Totally Enclosed, Fan Cooled, 55 C; 60 cycles, 550 volts and less.



(Dimensions in inches. New frame designations and dimensions on grey tone.)

Horsepower Ratings at Given RPM						Frame Number	A (Max.)	B (Max.)	D	E	F	BA	H	N-W	U	V (Min.)	XA	XB	XC
3600*	1800	1200	900	720	600														
1-1/2	1	3/4	—	—	—	203	10	7-1/2	5	4	2-3/4	3-1/8	13/32	2-1/4	3/4	2	3/16	3/16	1-3/8
						182	9	6-1/2	4-1/2	3-3/4	2-1/4	2-3/4	13/32	2-1/4	7/8	2	3/16	3/16	1-3/8
—	—	—	1/2	—	—	204	10	8-1/2	5	4	3-1/4	3-1/8	13/32	2-1/4	3/4	2	3/16	3/16	1-3/8
						182	9	6-1/2	4-1/2	3-3/4	2-1/4	2-3/4	13/32	2-1/4	7/8	2	3/16	3/16	1-3/8
2	1-1/2	1	—	—	—	204	10	8-1/2	5	4	3-1/4	3-1/8	13/32	2-1/4	3/4	2	3/16	3/16	1-3/8
						184	9	7-1/2	4-1/2	3-3/4	2-3/4	2-3/4	13/32	2-1/4	7/8	2	3/16	3/16	1-3/8
3	2	1-1/2	3/4	—	—	224	11	8-3/8	5-1/2	4-1/2	3-3/8	3-1/2	13/32	3	1	2-3/4	1/4	1/4	2
						184	9	7-1/2	4-1/2	3-3/4	2-3/4	2-3/4	13/32	2-1/4	7/8	2	3/16	3/16	1-3/8
5	3	2	1	—	—	225	11	9-1/2	5-1/2	4-1/2	3-3/4	3-1/2	13/32	3	1	2-3/4	1/4	1/4	2
						213	10-1/2	7-1/2	5-1/4	4-1/4	2-3/4	3-1/2	13/32	3	1-1/8	2-3/4	1/4	1/4	2
—	—	—	1-1/2	1	—	254	12-1/2	10-3/4	6-1/4	5	4-1/8	4-1/4	17/32	3-3/8	1-1/8	3-1/8	1/4	1/4	2-3/8
						213	10-1/2	7-1/2	5-1/4	4-1/4	2-3/4	3-1/2	13/32	3	1-1/8	2-3/4	1/4	1/4	2
7-1/2	5	3	2	1-1/2	1	254	12-1/2	10-3/4	6-1/4	5	4-1/8	4-1/4	17/32	3-3/8	1-1/8	3-1/8	1/4	1/4	2-3/8
						215	10-1/2	9	5-1/4	4-1/4	3-1/2	3-1/2	13/32	3	1-1/8	2-3/4	1/4	1/4	2
10	7-1/2	5	3	2	1-1/2	284	14	12-1/2	7	5-1/2	4-3/4	4-3/4	17/32	3-3/4	1-1/4	3-1/2	1/4	1/4	2-3/4
						254 U	12-1/2	10-3/4	6-1/4	5	4-1/8	4-1/4	17/32	3-3/4	1-3/8	3-1/2	5/16	5/16	2-3/4
15	10	7-1/2	5	3	2	324	16	14	8	6-1/4	5-1/4	5-1/4	21/32	4-7/8	1-5/8	4-5/8	3/8	3/8	3-3/4
						256 U	12-1/2	12-1/2	6-1/4	5	5	4-1/4	17/32	3-3/4	1-3/8	3-1/2	5/16	5/16	2-3/4
DP	TEFC	DP	TEFC																
20	—	15	15	10	7-1/2	326	16	15-1/2	8	6-1/4	6	5-1/4	21/32	4-7/8	1-5/8	4-5/8	3/8	3/8	3-3/4
						284 U	14	12-1/2	7	5-1/2	4-3/4	4-3/4	17/32	4-7/8	1-5/8	4-5/8	3/8	3/8	3-3/4
—	20	—	—	—	—	326	16	15-1/2	8	6-1/4	6	5-1/4	21/32	4-7/8	1-5/8	4-5/8	3/8	3/8	3-3/4
						286 U	14	14	7	5-1/2	5-1/2	4-3/4	17/32	4-7/8	1-5/8	4-5/8	3/8	3/8	3-3/4
—	—	20	20	—	10	364	18	15-1/4	9	7	5-5/8	5-7/8	21/32	5-5/8	1-7/8	5-3/8	1/2	1/2	4-1/4
						286 U	14	14	7	5-1/2	5-1/2	4-3/4	17/32	4-7/8	1-5/8	4-5/8	3/8	3/8	3-3/4
25	—	—	—	—	—	364 S	18	15-1/4	9	7	5-5/8	5-7/8	21/32	3-1/4	1-5/8	3	3/8	3/8	1-7/8
						286 U	14	14	7	5-1/2	5-1/2	4-3/4	17/32	4-7/8	1-5/8	4-5/8	3/8	3/8	3-3/4
—	—	25	—	15	—	364	18	15-1/4	9	7	5-5/8	5-7/8	21/32	5-5/8	1-7/8	5-3/8	1/2	1/2	4-1/4
						324 U	16	14	8	6-1/4	5-1/4	5-1/4	21/32	5-5/8	1-7/8	5-3/8	1/2	1/2	4-1/4
30	—	—	—	—	—	364 S	18	15-1/4	9	7	5-5/8	5-7/8	21/32	3-1/4	1-5/8	3	3/8	3/8	1-7/8
						324 S	16	14	8	6-1/4	5-1/4	5-1/4	21/32	3-1/4	1-5/8	3	3/8	3/8	1-7/8
—	—	30	25	20	15	365	18	16-1/4	9	7	6-1/8	5-7/8	21/32	5-5/8	1-7/8	5-3/8	1/2	1/2	4-1/4
						326 U	16	15-1/2	8	6-1/4	6	5-1/4	21/32	5-5/8	1-7/8	5-3/8	1/2	1/2	4-1/4
40	25	—	—	—	—	365 S	18	16-1/4	9	7	6-1/8	5-7/8	21/32	3-1/4	1-5/8	3	3/8	3/8	1-7/8
						326 S	16	15-1/2	8	6-1/4	6	5-1/4	21/32	3-1/4	1-5/8	3	3/8	3/8	1-7/8

*Design A and B only.

(Courtesy Westinghouse Electric Corp.)

Advertising In This Issue

Abolite Lighting Div.
Jones Metal Products Co..... 172
• Accurate Mfg. Co..... 31
Adalet Mfg. Co., The..... 166
• Adam Electric Co., Frank..... 10
Allen-Bradley Co. 163, 164
Allis Co., The Louis..... 21
Allis-Chalmers Mfg. Co...18, 19, 25, 57
• All-Steel Equipment, Inc..... 35
Alter Co., The Harry..... 184
Aluminum Co. of America..... 178
• American Brass Co., The
American Metal Hose Branch..... 119
Anaconda Wire & Cable Co..... 62
Anthony Co., F. M..... 180
Appleton Electric Co..... 2
• Arro Expansion Bolt Co..... 122
Art Metal Co., The..... 103

• Barth Corp., The..... 185
Benjamin Electric Mfg. Co..... 27
• Bernz Co., Inc., Otto..... 191
Biddle Co., James G..... 147
Blackhawk Mfg. Co..... 190
• Borthig Co., Inc., George C..... 112
Briegel Method Tool Co..... 30
Bryant Electric Co., The..... 24
• Buffalo Forge Co..... 134
BullDog Electric Products Co..... 117
• Burndy Engineering Co..... 97

Century Electric Co..... 11
Champion DeArment Tool Co..... 192
• Columbia Cable & Elec. Corp..... 34
• Cope, Inc., T. J..... 127
Corning Glass Works..... 115
• Crescent Ins. Wire & Cable Co..... 58
• Crouse-Hinds Co. 4, 5
Crown Industrial Prods. Co..... 191
• Curtis Lighting, Inc..... 181
Cutler-Hammer, Inc. 38

• Day-Brite Lighting, Inc..... 154
Dossert Mfg. Corp..... 188

Edwards Co., Inc..... 142
Efficiency Elec. & Mfg. Co..... 166
Electric Service Mfg. Co.....44, 45
Electric Storage Battery Co.....52, 53
Electrical Fittings Corp..... 104
Electromode Corp. 183
Erico Products, Inc..... 55

• Federal Electric Products Co.....60, 145
Fullman Mfg. Co..... 138

• G&W Electric Specialty Co..... 153
General Cable Corp..... 17
• General Electric Co. (Apparatus Dept.)
Second Cover, 12, 13, 16, 20, 106, 107
• (Construction Materials Dept.)
Fourth Cover, 128
General Electric Co (Lamp Dept.)..... 171
Gets-A-Lite Co. 188
• Graybar Electric Co., Inc..... 64
Greenlee Tool Co..... 151
• Guth Co., The Edwin F..... 141

Haynes Products Co..... 193
Hazard Insulated Wire Works..... 42
Helwig Co. 186
Hubbell, Inc., Harvey..... 149

• Ideal Industries, Inc..... 135
International Business Machines..... 50
• International Register Co..... 189
• I-T-E Circuit Breaker Co.....22, 23

• Jackson Electrical Co..... 190
• Johns-Manville 32
Jones Metal Products Co., The..... 172
Joy Manufacturing Co..... 168

Kalamazoo Tank & Silo Co..... 186
Keystone Mfg. Co..... 182
Klein & Sons, Mathias..... 102

• Leviton Mfg. Co..... 169
Litecontrol Corp. 54

• McGill Mfg. Co., Inc..... 48
McGraw-Hill Book Co..... 193
• Midwest Electric Mfg. Co..... 132
• Minerallac Electric Co..... 190
Moloney Electric Company..... 7
• Multi Electric Mfg. Co..... 182
• Murray Mfg. Corp..... 1

• National Electric Prods. Corp.....28, 29
Natvar Corp. 39
Newman Industries (America) Inc.... 43

• Okonite Co., The..... 42
Onan & Sons, Inc., D. W..... 144
• Oster Mfg. Co., The..... 173

• Parr Electric Co., Inc..... 186
• Pass & Seymour, Inc..... 98
• Phelps Dodge Copper Products Corp.
8, 9
• Pierce Renewable Fuses, Inc..... 146
Pittsburgh Reflector Co..... 187
• Porcelain Products, Inc..... 124
Powder Power Tool Corp..... 159
Powercraft Corp. 192
• Precision Transformer Corp..... 180
• Preformed Line Products Co..... 126
Pressure Can Corp..... 140
Pyle-National Co., The..... 46
Pyramid Instrument Corp..... 113

• Quadrangle Mfg. Co..... 156

Ramset Fasteners Inc..... 165
Republic Steel Corp.....40, 41
Revere Electric Mfg. Co..... 184
Ridge Tool Co., The..... 116
RLM Standard Institute Inc..... 14
Roebling's Sons Co., John A..... 51
• Rome Cable Corp.....36, 37
Royal Electric Co., Inc..... 170

S&C Electric Co..... 47
Sherman Mfg. Co., H. B..... 174
Signal Electric Mfg. Co..... 152
• Signal Engineering & Mfg. Co..... 158
Silvray Lighting, Inc..... 139
Simplex Wire & Cable Co..... 15
Smithcraft Lighting Division.....33, 105
Sola Electric Co..... 157
• Sorgel Elec. Company..... 114
Spang-Chalfant (Div. of the National
Supply Co.) 6
Spero Electric Corp., The..... 188
Sperti Faraday, Inc..... 168
Sprague Electric Co..... 189
Square D Co.....Third Cover, 160
• Standard Transformer Co..... 172
Steel & Tubes Division.....40, 41
Sterling Electric Motors..... 49
Sticht Co., Inc., Herman H..... 184
• Sylvania Electric Products, Inc..... 148

Tal Bender, Inc..... 174
• Thiel Tool and Engineering Co..... 192
Thomas & Betts Co., The..... 108
Trumbull Dept. General Electric Co.. 123

Unistrut Products Co..... 121
• United States Rubber Co..... 125

• Wagner Electric Corp.....110, 175
• Wagner Malleable Products Co..... 158
Wakefield Brass Co., F. W. The..... 100
• Ware Fuse Corp..... 143
• Western Insulated Wire Co.....136, 137
Weston Electrical Instrument Corp... 56
• Wheeler Reflector Co..... 167
Where To Buy..... 193
Wiremold Co., The..... 150
Wodack Electric Tool Corp..... 193

Youngstown Sheet & Tube Co..... 26

SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

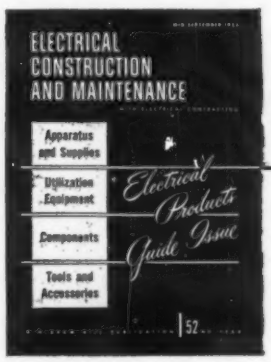
EMPLOYMENT
Positions Vacant 193
Positions Wanted 193

EDUCATIONAL
Books 193

BUSINESS OPPORTUNITIES
Offered 193

EQUIPMENT
(Used or Surplus New)
For Sale 193

WANTED
Equipment 193



• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE

For more complete information, and application data on their lines, refer to the Index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

MAKE THE JOB EASIER with XO CIRCUIT BREAKERS

I'm sold on XO breakers because they're EASIER TO BUY!

You'll find that XO breakers are EASIER TO SELECT!

Know why I like 'em? Because they're EASIER TO INSTALL!

I give the nod to XO breakers because they're EASIER TO LIVE WITH!

Here's why XO Breakers are—

EASIER TO SELECT!

Wide Range of Devices, 1 to 32 Circuits • Main Breakers or Main Lugs • 1 Phase 3 Wire or 3 Phase 4 Wire • Available in either General Purpose or Raintight Enclosures

EASIER TO BUY!

Off-the-Shelf Delivery from Distributor's Stock • Only 3 Basic Components: Box-Interior, Breakers, and Cover • Simplified Packaging

EASIER TO INSTALL!

PLUG-IN BREAKERS: Load Lugs Easily Accessible from Front • No Wire Looping • ENCLOSURES: Matching Knockouts • Plenty of Wiring Space • Adjustable Interiors

EASIER TO LIVE WITH!

Attractive Appearance • Rugged Breaker Design • Positive Operation • Long Life • Ambient Compensated • Non-Interchangeable Units discourage tampering

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

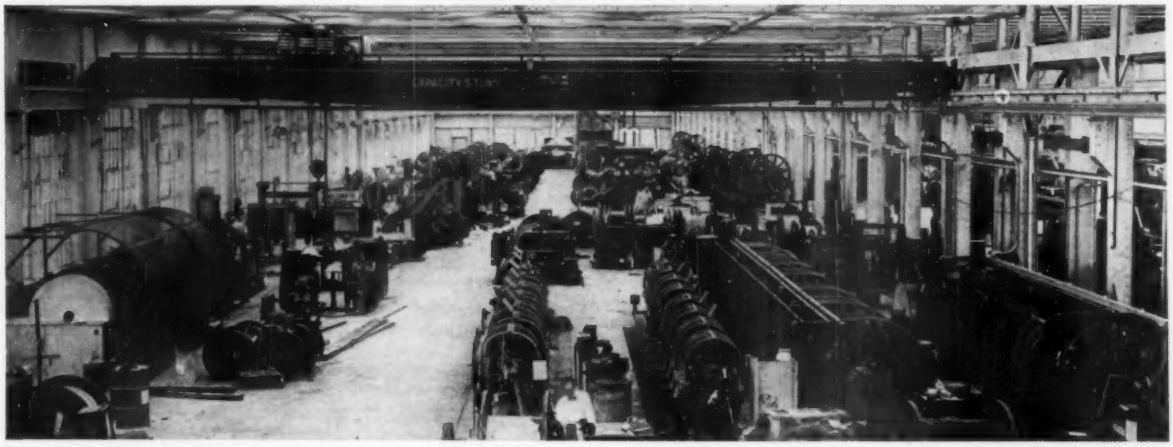
INCREASING USE OF ELECTRICITY CALLS FOR MODERN DISTRIBUTION SYSTEMS

General Electric's expanding wire and cable facilities and services can help you serve your customers

The continuing development of new electrical equipment, processes, and materials handling methods doubles the use of electricity about every ten years—according to the findings of qualified authorities. This growing load will call for bigger and more flexible distribution systems and wire and cable installations. To help you serve your customers, General Electric has expanded its facilities, and is prepared to assist in the application, use, and maintenance of modern distribution systems.

1 PLANNING AND APPLICATION.

G-E wire and cable specialists are ready to help you select and plan cable systems with the capacity and flexibility needed for growing loads.



2 WIRE AND CABLE AVAILABILITY.

General Electric is adding a new wire and cable plant to its facilities in Bridgeport, Connecticut, to continue to supply you with the products on which cable systems depend. This new plant will be able to produce more cable faster, and will supply you with new cable products to meet new needs.

If you want help NOW . . . just call your G-E wire and cable specialist, or write Section W123A-218, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

3 MAINTENANCE OF CABLE SYSTEMS.

G-E test facilities minimize your customers' maintenance problems. Thorough production-line testing, coupled with research and developmental testing, give you wire and cable products with longer life and coordinated insulation levels. (This spectrographic test for copper conductor purity is one example of G.E.'s laboratory testing.)

You can put your confidence in—

GENERAL ELECTRIC